TP 4568E

ADVANCED TECHNOLOGY ON

JAPANESE NATIONAL RAILWAYS

Prepared For

Transportation Development Centre
Transport Canada

June, 1983

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Advanced Technology On

Japanese National Railways

R. G. Maughan

Maughan Railway Consulting
Services Inc.

June 1983

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17. Abstract

Differences between Canadian and Japanese railways with respect to axle loads, freight passenger traffic levels and other significant operating parameters are identified, and the influence of these differences on research and development priorities are discussed. The Japanese National Railway (JNR) track recorder car and Japanese work on systems for the remote inspection of moving rolling stock and development of "anti-snow" freight car brake shoes are discussed and conclusions drawn as to the potential benefit of these developments to Canadian railways. Statistics on all modes of transportation in Japan are presented as well as facts and figures for the national railways for the year 1981.

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15. Remarques additionnelles	16. Agent de projet — CDT
	D.W. Dibble

17. Résumé

Ce rapport présente les principales caractéristiques qui différencient les réseaux de chemin de fer canadiens et japonais: charges d'essieux, importance relative des trafics marchandises et voyageurs, et divers autres paramètres d'exploitation significatifs. Puis, à la lumière de ces différences, il explique l'évolution divergente de l'ordre des priorités dans ces deux pays en matière de recherche et de développement ferroviaires. Il décrit notamment la voiture d'auscultation de voie mise au point par les Japonais ainsi que leurs travaux sur les systèmes d'inspection à distance du matériel roulant et les sabots de frein "pare-neige" qui préviennent les pannes de freinage attribuables à l'accumulation de cette substance entre les sabots et les bandages de roues. Enfin, il montre comment les chemins de fer canadiens pourraient mettre à profit ces perfectionnements technologiques. Suivent ensuite des données statistiques sur l'ensemble des modes de transport au Japon et une revue des activités des chemins de fer nationaux japonais en 1981.

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The cooperation and assistance provided by personnel of Canadian National Railways, Canadian Pacific Ltd., the Japanese National Railways and the several industries and private railways visited in Japan, is also acknowledged with warm thanks.

TABLE OF CONTENTS

1.	INTRODUCTION	1
2.	RAILWAY OPERATING PARAMETERS AND R & D PRIORITIES	2
	2.1 Differences in Operating Paramaters	2
	2.2 Opportunity for Technology Transfer	3
3.	THREE JNR DEVELOPMENTS OF APPARENT POTENTIAL BENEFIT TO CANADIAN RAILWAYS	4
	3.1 Track Recorder Car and Scheduled Track Maintenance	4
	3.1.1 Discussion	4
	3.1.2 Recommendation	5
	3.2 Remote Inspection of Moving Rolling Stock	5
	3.2.1 Discussion	5
	3.2.2 Recommendation	5
	3.3 Freight Car Brake Shoes	6
	3.3.1 Discussion	6
	3.3.2 Recommendation	6
4.	APPENDICES	
	APPENDIX A - STUDY TEAM	
	APPENDIX B - MEETINGS AND VISITS	
	APPENDIX C - PRESENT SITUATION OF JAPANESE RAILWAYS	
	APPENDIX D - 1982 FACTS AND FIGURES JAPANESE NATIONAL RAILWAYS	

1. INTRODUCTION

Under a shared cost contract between the Railway Association of Canada and the Transport Canada Transportation Development Centre (TDC), four Canadian railway technical officers visited Japan from March 26 to April 11, 1983, with the objective of studying advanced technology used on Japanese National Railways (JNR), and identifying those systems that could improve operations on Canadian railways. Under a separate shared cost contract with TDC, and with the same objective and schedule, the author of this report made up the fifth member of the team.

The author, like each of the other team members, took part in all of the meetings and visits in Japan and collaborated with the Railway Association of Canada team members in the preparation of their report "Study of Advanced Technology on Japanese National Railways", TP 4543E. Inasmuch as report TP 4543E contains all of the pertinent information on advanced technology derived by the team, this report is brief. It includes a short discussion of the differences between the Canadian and Japanese railway operating parameters from the standpoint of their influence on R & D priorities and, as well, comments regarding three of the several JNR technical developments which it appears might be of benefit to Canadian railways.

Names and company affiliation of the team members are shown in Appendix A. A listing of all the meetings and visits which took place in Japan relative to the assignment is provided in Appendix B. Useful and interesting statistics and information concerning the overall transportation situation in Japan, provided by the Japanese Ministry of Transport, appears in Appendix C. Appendix D consists of the 1982 edition of the JNR booklet Facts and Figures.

2. RAILWAY OPERATING PARAMETERS AND R & D PRIORITIES

2.1 Differences in Operating Parameters

The ultimate objectives of railway R & D throughout the world are similar -- to increase profit and improve safety. However, it does not follow that R & D priorities are the same on all railways. This circumstance is not unique to railways -- it holds true for most industries. R & D is a response to identified problems, and to a large extent, problems in any business enterprise are a reflection of its operating parameters.

There are significant differences between the Japanese and Canadian railway operating parameters, the most important of which are:

- the relative importance of freight vs passenger traffic
- axle load and train length
- route length
- type of traction

Unquestionably, passenger traffic is the most important side of Japanese railway operations. On the JNR, passenger revenues in 1981 were close to eight times greater than freight revenues (approximately $ Can. 1.2 billion vs .15 billion). Even excluding the Shinkansen operation, they were in excess of six times freight revenues. This is a complete reversal of the Canadian situation.

For many years, the share of total domestic freight tonnage carried by JNR has been small. Although in 1950 its share was 26%, it fell rapidly to 4% by 1970. By 1980 it was only 2% and the decision has now been made to significantly curtail railway freight services in order to balance costs with revenues. Within the next three years approximately half of the present 851 freight stations will be closed and personnel engaged in freight services will be cut back to about half of the present 50,000. It is also the intention to close all of the automated freight classification yards and operate only "point-to-point" trains between key terminals where demand for JNR freight services still remain high. In areas where JNR services are abolished, trucks will be used in place of freight trains. Not surprisingly, under all of these circumstances, JNR's current R & D emphasis is on improvement to passenger operations.

Even were it the case that a higher proportion of the JNR R & D was concerned directly with freight operations, other major differences in their operating circumstances relative to those on Canadian railways suggest that, at least from the standpoint of technical research, it is

unlikely that their R & D priorities would be the same as those on Canadian railways. There are appreciable differences between Canadian and Japanese rolling stock, perhaps the most significant of which is that JNR axle loads are little more than half of ours. Additionally, long trains (by Canadian standards) are not operated in Japan. Route lengths are short, and approximately 75% of all their train km, both passenger and freight, occur on electrified territory.

2.2 Opportunity for Technology Transfer

The differences noted above between the Japanese and Canadian railways would not be expected to influence the relativity of priorities for operations research to the same extent they would the priorities for technical research. There is, on the railway networks of both nations, a great need for the system-wide economies which are achievable through improved information flow and systems, computer simulations of various kinds, maintenance planning and control systems, more efficient materials handling systems and a host of other operational betterments. It is, therefore, reasonable to expect that the exchange of information or even more formal cooperative programs with respect to at least some of these matters would be beneficial. That indeed was found by the study team to be the case, as is discussed in report TP 4543E.

Even from the standpoint of purely technical developments, the differences between the two railway systems are obviously not sufficiently great to entirely preclude the Canadian adaptation of a new and effective Japanese product - such as an improved brake shoe material. It is equally obvious that in some matters the direct adoption of a JNR development would be possible, as for example, the use of improved Japanese rail which is already on test in Canada. In either case, of course, a perceived benefit, achievable at a faster rate and/or lower cost than could be achieved on their own, would be an evident prerequisite of a Canadian railway before entering into any kind of arrangement with JNR. From the Japanese point of view, the same prerequisite would apply.

Nevertheless, it appears that the window of opportunity for mutually beneficial cooperation in development of railway technology is not too wide. It does appear, however, that further exploration of certain existing Japanese railway technological developments, both operational and technical, could result in benefit to Canadian railways. These are identified in report TP 4543E and three of them are discussed briefly in the remaining section of this report.

3. THREE JNR DEVELOPMENTS OF APPARENT POTENTIAL BENEFIT TO CANADIAN RAILWAYS

3.1 Track Recorder Car and Scheduled Track Maintenance

3.1.1 Discussion

Unsuccessful attempts were made by the Canadian team to arrange to ride one of the JNR track recorder cars. Their newest car (for use on the Tocohu and Joetsu Shinkansen line) happened to be in the shop at Sendai during the team's visit there, but due to the absence of the specialized JNR personnel and the lack of time, it was not possible to gain any greater appreciation of the car's capability or the system for its use than had been obtained during previous limited discussions at the Railway Research Institute.

From those discussions, it appears that the JNR car has superior capabilities for measurement of track quality than do the cars employed on Canadian lines. We were told that measurement of alignment is done optically and that a gyroscope is employed for cross level. Reliability of measurement was said to be within 0.3 mm. Data produced is recorded on magnetic tape on-board, which is subsequently fed into an on-ground computer which produces a listing of necessary remedial work for transmission to the appropriate work depot. It was said that the data produced is presently also being used for planning purposes, and efforts are currently being made to utilize it for prediction of specific track maintenance requirements.

A capability for early detection of small differences in track quality to ensure safe and comfortable operation of the high speed Shinkansen trains is obviously necessary, and is apparently being achieved by JNR by means of their equipment, which is self-propelled, operated every 10 days and augmented by vibration measurement equipment on the passenger trains. It is unlikely that an ability to measure to an accuracy of 0.3 mm is necessary, even on the Shinkansen, particularly since it is even more unlikely that track can be adjusted that finely. Certainly, such fine adjustment would not be possible on the typical Canadian ballasted track, nor, in the light of the much slower train speeds here, would it be necessary. However, adaptation, or even direct utilization, of the JNR technology for the measurement of track quality on Canadian railways does not imply a requirement to maintain the Canadian track to the quality level of the high speed Shinkansen concrete slab track. Actual track quality can be allowed to deteriorate to any pre-selected level before remedial work is undertaken, regardless of the accuracy of the quality measurement system.

No information was obtained from JNR on how the data obtained by the recorder car is employed for maintenance planning. Considerable effort has been expended to this end on North American railroads with,

as yet, no significant success. It involves correlation of the recorder car output over time with large amounts of other information including past and anticipated traffic levels, derailments and their cause and cost. The Southern Railway has been one of the leaders in this work in North America and the present status of their work is outlined in the March, 1983, issue of "Railway Track and Structures".

3.1.2 Recommendation

If the development of an improved ability for track quality measurement is a requirement on Canadian railways, all available literature relative to the JNR car should be reviewed with a view to possibly initiating discussions with JNR regarding utilization of their technology.

3.2 Remote Inspection of Moving Rolling Stock

3.2.1 Discussion

JNR has developed prototype devices for automatic wheel inspection. Three of the devices are said to be capable of measuring, at speeds up to 32 km/h, wheel tread diameter, back-to-back wheel gauge and the cross-sectional profile of the flange. These are intended for use on a track approaching an inspection and repair shop. The wheel data and car number are transmitted through cables to the shop, with any item which exceeds specified limits highlighted. Other devices, to be located on main track, have been developed for the detection of abnormal vibration of wheels, including detection of wheel flats. All of these were said to be under test on their Shinkansen General Test Line, along with other devices for detection of pantograph pan wear and pantograph pressure. They are all described more fully in the team report TP 4543E.

Recognition of the serious consequences of any failure of pantographs or wheels on the high-speed Shinkansen lines motivated these developments. In addition to improving the accuracy of inspection, such equipment would reduce inspection time and costs.

It is also understood that devices for the detection of eccentrically loaded cars (i.e. unequal wheel loads due to unbalanced cargo), have been developed and that twelve of these have been installed at various yards throughout the system.

3.2.2 Recommendation

Wheel changeout is, by a wide margin, the single most costly car maintenance item on North American railways. Despite careful wheel

inspection, derailments occur due to service failures. It is recommended that the Freight Car Working Group of the Railway Advisory Committee be requested to explore the potential utilization and benefit to Canadian railways of devices such as those described above, and make recommendations as to whether the subject should be pursued with JNR.

3.3 Freight Car Brake Shoes

3.3.1 Discussion

Investigations are currently being carried out in Canada directed towards development of a freight car brake shoe material which would eliminate the possibility of formation of an ice film on the shoe, a condition which is believed to occur under certain combinations of ambient temperature and precipitation. This same objective is being pursued on JNR.

On JNR, three types of "anti-snow" brake shoes have been developed and tested on full-size laboratory apparatus. The shoes and apparatus were viewed by the Canadian team, and the work is described in a series of four articles published in the JNR Quarterly Reports. Copies of these articles are included in the appendices to the team report TP 4543E. It is evident that there is potential benefit to the Canadian work in establishing a program of cooperation with JNR on this subject.

3.3.2 Recommendation

Steps should be taken to obtain a sample of each of the three types of Japanese "anti-snow" brake shoes, for inclusion in the CP Rail/NRC program of testing and evaluation.

APPENDIX A - STUDY TEAM

Mr. Con Bach
System Manager
Operational Research & Industrial Engineering
Canadian National Railways

Mr. A. E. Bethune
Director
Technical & Operations Research
Canadian Pacific Ltd.

Mr. D. E. Welsh
Manager, Financial and Systems Planning
Mechanical Department
CP Rail

Mr. V. W. Shtenko
Chief Engineer
British Columbia Railway

Mr. R. G. Maughan
Vice-President
Maughan Railway Consulting Services Inc.

APPENDIX B

MEETINGS AND VISITS

	Date and Location	Persons Present*	Purpose
	March 27 - Tokyo		
1.	President Hotel (10:00 - 11:30 hrs.)	T. Kunita - Manager, Japan, Korea & Taiwan - CNR, Tokyo S. Ashizawa - Senior Sales Rep'tve. - CNR, Tokyo	Familiarization with arrangements made by JNR & CN for travel during mission and for interpreter services.
	March 28 - Tokyo		
2.	Chancery, Canadian Embassy (09:00 - 09:45 hrs.)	J. MacDowall - Counsellor, (Science & Technology) Cdn. Embassy A. Rusinek - First Secretary (Commercial) Cdn. Embassy	Orientation.
3.	Ministry of Transport (10:00 - 11:00 hrs.)	Mr. Hashimoto - Director, General Affairs Div., Rly. Supervisory Bureau Ministry of Transport J. MacDowall - Canadian Embassy	Overview of Japanese transport scene.
4.	Japanese National Rlys., H.Q. International Department (11:15 - 12:30 hrs.)	Kazuo Matsuki - Assistant to the Director International Department, JNR Yoshihiro Kyotani - Director Technical Develop. Dept., JNR Yukio Suzuki - Senior Staff, International Department, JNR	Review of Itinerary.
5.	Japanese National Rlys., H.Q. International Department (13:30 - 17:15 hrs.)	Kazuo Matsuki - Assistant to the Director International Department, JNR Yukio Suzuki - Senior Staff, Intern'l. Dept., JNR K. Nagai - Deputy Director Information Systems, JNR Yukao Kimura - Senior Researcher, Information Systems Lab., Rly. Technical Research Institute, JNR H. Soejima - Deputy Director of Rolling Stock Section, JNR Tshuchida - J. MacDowall - Canadian Embassy Hotsumi Harada - Director Intern'l. Affairs Dept. JNR (briefly following conclusion of meeting)	Presentations by Canadian team members.

* In addition to Canadian team members

MEETINGS AND VISITS

Date and Location	Persons Present*	Purpose
March 29 - Tokyo JNR Shinkansen Control Centres (10:00 - 12:00 hrs.)	Kazuo Matsuki - Assistant to the Director International Dept., JNR Chief Dispatchers - JNR	Explanation of Shinkansen train control systems.
7. Japanese National Rlys., H.Q. International Department (13:00 - 17:00 hrs.)	Kazuo Matsuki - Assistant to the Director International Dept., JNR Mr. Omori - Manager, Freight Dept., JNR K. Nagai - Deputy Director, Information Systems, JNR H. Soejima - Deputy Director of Rolling Stock Section, JNR S. Matsuyama - Steel & Alloy Lab., Rly. Tech. Res. Inst., JNR	Overview of significant technical developments on JNR.
March 30 Tokyo Shinkansen (Tokaido) Car Maintenance Depot (10:00 - 12:15 hrs.)	Kazuo Matsuki - Assistant to the Director International Dept., JNR Mr. Kawakami - Chief, Tokyo Car Maintenance Depot, JNR Mr. Oikawa - Deputy Chief, Tokyo Car Maintenance Depot, JNR	Overview of Shinkansen (Tokaido) car maintenance system and facilities.
JNR Railway Technical Research Institute (Kunitachi) (14:30 - 17:00 hrs.)	Takeshi Sugiyama - Vice-Director Masaru Ishiyama - Ryoichi Masuda - Technical Inform. Centre Makoto Hayashi - Chief, Train Operations Lab. Katsuro Takasawa - Chief, Metallic Materials Lab. Tado Ohyama - Senior Research Engineer Car Braking Lab. Kazuo Matsuki - Asst. to the Director International Dept., JNR Kaname Idumura - Chief Researcher Car Braking Lab.	Overview of Railway Technical Research Institute and viewing of experiments/testing underway in train simulation, rail and brake shoes.

OTE: Unless otherwise noted, all "persons present" are employed at the Research Institute.

In addition to Canadian team members

MEETINGS AND VISITS

Date and Location	Persons Present*	Purpose
March 31 - Tokyo 10. JNR Railway Technical Research Institute (Kunitachi) (10:00 - 17:00 hrs.)	Takeshi Sugiyama - Vice-Director Ryoichi Masuda - Technical Information Centre Sawase - Senior Researcher, Machinery Systems Lab Furuki - Senior Researcher, Machinery Systems Lab Yoshihiko Sato - Chief, Track Lab Teranaga - Senior Researcher, Track Lab Nagasqula - Sr. Researcher, Control Engineering Lab Todoroki - Sr. Researcher, Cntrl. Eng. Lab Shioya - Sr. Researcher, Cntrl. Eng. Lab Tanabe - Sr. Researcher, Cntrl. Eng. Lab Makoto Hayashi - Chief, Train Operations Lab Yukio Kimura - Sr. Researcher, Info. Sys. Lab Sasaki - Sr. Researcher, Signalling Lab Dr. Tanaka - Chief, Car Structure Lab Katsuro Takasawa - Chief, Metallic Materials Lab Masayuki Miyamoto - Fellow Research Engineer, Car Dynamics Lab Kaname Idemura - Chief Researcher, Car Braking Lab Tadao Ohyama - Sr. Researcher Engineer, Car Braking Lab Shinobu Yasukaik - Sr. Researcher, Car Performance Lab	Presentations by Canadian Team (1 hr.) Technical discussions for balance of day.
NOTE : All "persons present" are employed at the Research Institute. Regretably, it proved impossible to record the names of many of the Institute personnel who took part in the many different discussions during this very interesting day.		
March 31, Tokyo 11. Technova Inc. Fukoku Seimei Bldg. (19:00 - 21:30 hrs.)	Tosnikazu Kurokawa - General Manager, Technova Inc Kiechi Oshima - Vice Chairman, Technova Inc. Yoshihiro Kyotoni - Director, Technical Development Dept., JNR Masakazu Igutchi - Professor, Dept. Mech. Eng. Univ. of Tokyo Takehiko Fujioka - Lecturer, Dept. Mech. Eng. Univ. of Tokyo	To discuss progress made with their contract on robotics research.

* In addition to Canadian team members

MEETINGS AND VISITS

	Date and Location	Persons Present*	Purpose
	April 1, Tokyo/Kyoto		
12.	JNR Marshalling Yard (Shiohama) (10:00 - 12:30 hrs.)	Kikuo Arai - Traffic Dept., Tokyo South Rly. Operating Div., JNR - Station Master, Shiohama Marshalling Yard Mr. Koyama - Deputy Stn. Master Shiohama Marshalling Yard	To view automated yard equipment and operation.
	To Kyoto via Shinkansen (Tokaido) Express train at 15:00 hrs. Apr. 1, Departed Kyoto Mon. Apr. 4 via Shinkansen (Tokaido) Local train at 08:21 hrs. Arrived Toyokawa City at 09:55 hrs.		
	April 4, Toyokawa City		
13.	Offices & shops of Nippon Sharyo Seizo Kaisha Ltd. (Japan Rolling Stock Mfg. Co. Ltd.) (10:15 - 13:00 hrs.)	K. Hirai - Director, Chief Engr. Rolling Stock Tech. Dept. Japan Rolling Stock Ltd. Itsu Nagami - General Manager, Export Planning & Eng., Japan Rolling Stock Ltd. Junji Togashi - Deputy Project Mgr., Argentine EC Project, Japan Rolling Stock Ltd.	To ascretain extent and type of robotics employed.
	Taxi to Toyota City		
14.	**April 4, Toyota City** Toyota Auto Manufacturing Head Office & Tsumi Assembly Plant (14:00 - 15:40 hrs.)	Isao Taniguchi - Manager, Public and Community Relations Akemi Maito - Public and Community Relations	To ascertain extent and type of robotics employed.
	Taxi to Toyokawa City - Shinkansen (Tokaido) Local train at 17:07 hrs. arriving Tokyo 19:28 hrs.		

* in addition to Canadian team members

MEETINGS AND VISITS

Date and Location	Persons Present*		Purpose
April 5, Tokyo/Sendai Subway & commuter train to Omiya. Shinkansen (Tohoku) Express train at 10:00 hrs. arriving Sendai 11:59 hrs.			Overview of Shinkansen (Tohoku) car maintenance system and facilities.
15. Shinkansen (Tohoku) Car Maintenance Depot (14:00 - 17:00 hrs.)	Mr. Urayama	- General Affairs Div., Sales Dept., JNR Sendai	
	Mr. Kashimura	- Assistant Station Master JNR, Sendai	
	Mr. Yamamoto	- Director, Shinkansen Maintenance Depot, Shedai	
	Mr. Yamba	- Mgr. General Affairs Shinkansen Maintenance Depot	
	Mr. Oshida	- Manager, Inspection Shinkansen Maintenance Depot	
	Mr. M. Wakabayashi	- Director of Train Ops. Dept.	
	Mr. Oide	- Station Master	
April 6 - Sendai/Hitachi/Tokyo Departed Sendai via JNR passenger train at 09:25 hrs. arriving Hitachi 12:30 hrs.			
16. Offices, electric motor mfg. plant, and turbine generator mfg. plant of Hitachi Ltd., Hitachi (12:30 - 17:15 hrs.)	Hidetoshi Arakawa	- Rly. Equip. Dept. Hitachi Ltd., Tokyo	To ascertain extent and type of robotics employed.
	Toshiyuki Kondo	- Mgr., Motor Mfg. Dept. Hitachi Works	
	Ken-ichi Akaihashi	- Mgr., Motor Prod'n. Eng. Section, Hitachi Works	
	Takeshi Yamaguchi	- Mgr., Elec'l. Machine Design Dept., Hitachi Works	
	Yukiaki Shimizu	- Eng'r., Traction Motor Design Dept. - Hitachi Works	
	Tomoyuki Yoshimare	- Assistant Co-ordinator Yamate Business Adm. Section	
Departed Hitachi via JNR passenger train at 18:03 hrs., arriving Tokyo at 19:50 hrs.			

* In addition to Canadian team members

MEETINGS AND VISITS

	Date and Location	Persons Present*	Purpose
	April 7 - Tokyo		
17.	Technova Inc. Fukoku Seimei Bldg. (10:00 - 12:00 hrs.)	Tsutomu Yasui - Manager, Overseas Operations Technova Inc. Takehiko Fujioka - Lecturers, Dept. of Mechanical Eng., Univ. of Tokyo	To obtain additional information regarding material obtained at meeting March 31.
18.	Teito Rapid Transit Authority Office	Shoji Yanagawa - Ass't. Mgr., Public Relations Section, Teito R.T. Authority Masatochi Ohta - Ass't. to Gen. Mgr. (Foreign Affairs), Teito R.T. Authority Ryochi Yamada - Vice Director, Electricity Dept., Teito R.T. Authority Mr. Kurokawa - Rolling Stock Maintenance Teito R.T, Authority Masahiko Yamagato - Deputy Director, Electricity Dept., Teito R.T. Authority Satoru Miyakawa - Deputy Director, Train Op'ns. Dept., Teito R.T. Authority	To obtain information on operations and maintenance of subway.
	April 8 - Kumagaya		
	Mini-bus at 08:30 hrs. Tokyo to Kumagaya arriving Kumagaya 10:30 hrs.		
19.	Chichibu Tetsudo Railway Kumagaya - Offices & Facilities (10:30 - 16:30 hrs.)	Mr. Kakihara - President Chichibu Tetsudo Rly. Mr. Ishikawa - Managing Director, " " " Mr. Tomoro - Sales Manager, " " " Mr. Ishikawa - Director, Planning, " " " Mr. Gamo - General Manager, " " "	Overview of a private freight and passenger railway operation.
	Return via mini-bus to Tokyo arriving 19:30 hrs.		
	April 9 - 10		
	Tokyo to Nikko and return. No meetings.		

* In addition to Canadian team members

MEETINGS AND VISITS

Date and Location	Persons Present*	Purpose
April 11 - Tokyo		
20. Science & Technology Bldg. Canadian Embassy (09:00 - 09:30 hrs.)	J. MacDowall - Counsellor, (Science & Technology) Cdn. Embassy A. Rusinek - First Secretary (Commercial) Cdn. Embassy	Debriefing of team.
21. Science & Technology Bldg. Canadian Embassy (10:00 - 12:00 hrs.)	J. MacDowall - Counsellor (Science & Technol.) Cdn. Embassy Yoshro Kawakita - Manager, Japan, CP Rail Russ Steele - Managing Director, Far East and Australia, CN Rail D'arcy McGee - Counsellor, Metallurgy/Minerals Energy Representatives of the following Japanese businesses: Nippon Steel Ltd. Nippon Kokan K.K. (NKK) The Japan Iron & Steel Federation Japan Coal Development Co. Ltd. Sumitomo Metal Industries Ltd. The Federation of Electric Power Companies Nihon Keizai Shimbun Yomiuri Shimbum Keidanren	Presentations by Canadian team members, in response to special request by Mr. MacDowall.

* In addition to Canadian team members

APPENDIX C

PRESENT SITUATION OF JAPANESE RAILWAYS

（日本の鉄道の現況）

1983

CONTENTS
（目　次）

1. Transition of the Traffic Volume by Various Modes of Transport 1
（輸送機関別輸送量の推移）

1-(1) Domestic Freight Transport Tonnage 2
（国内貨物輸送トン数）

1-(2) Domestic Freight Transport Ton-Kilometers 3
（国内貨物輸送トンキロ）

1-(3) Passengers Carried 4
（輸送人員）

1-(4) Passenger-Kilometers Carried 5
（輸送人キロ）

2. Present State of Railway Service 6
（鉄道事業の現況）

3. Map of Shinkansen Lines and Cities with Subway 7
（国鉄新幹線及び地下鉄網路図（都市鉄道））

4. Outline of Shinkansen Lines 8
（新幹線の概要）

4-(1) Operating Results of Tokaido and Sanyo Shinkansen Lines 9
（東海道　山陽新幹線の営業収支実績の推移）

5. Passenger Traffic Volume by Various Modes of Transport in Three Major Urban Traffic Zones 10
（三大都市交通圏における交通機関別旅客輸送量）

5-(1) Three Major Urban Traffic Zones Total 11
（三大都市圏合計）

5-(2) Metropolitan (Tokyo) Traffic Zone 12
（首都交通圏）

5-(3) Chukyo (Nagoya) Traffic Zone 13
（中京交通圏）

5-(4) Keihanshin (Kyoto-Osaka-Kobe) Traffic Zone .. 14
（京阪神交通圏）

6. Outline of Subways 15
（地下鉄の概要）

7. Transition of Construction Cost of Subways per Kilometer 16
（地下鉄キロ当り建設費の推移）

8. Subsidies to Subways 16
（地下鉄に対する助成制度）

9. Mutual Through Service 17
（相互直通運転）

10. Outline of Monorail 18
（モノレールの概要）

11. Outline of New People Mover System 22
（新交通システムの概要）

12. Comparison of Shinkansen and French TGV 24
（新幹線とＴＧＶとの比較）

Reference
（参考）

Organization of Ministry of Transport
（運輸省組織図）

1. Transition of the Traffic Volume by Various Modes of Transport (Statistical Data of District Land Transport Bureau)
（輸送機関別輸送量の推移）　（陸運統計要覧による）

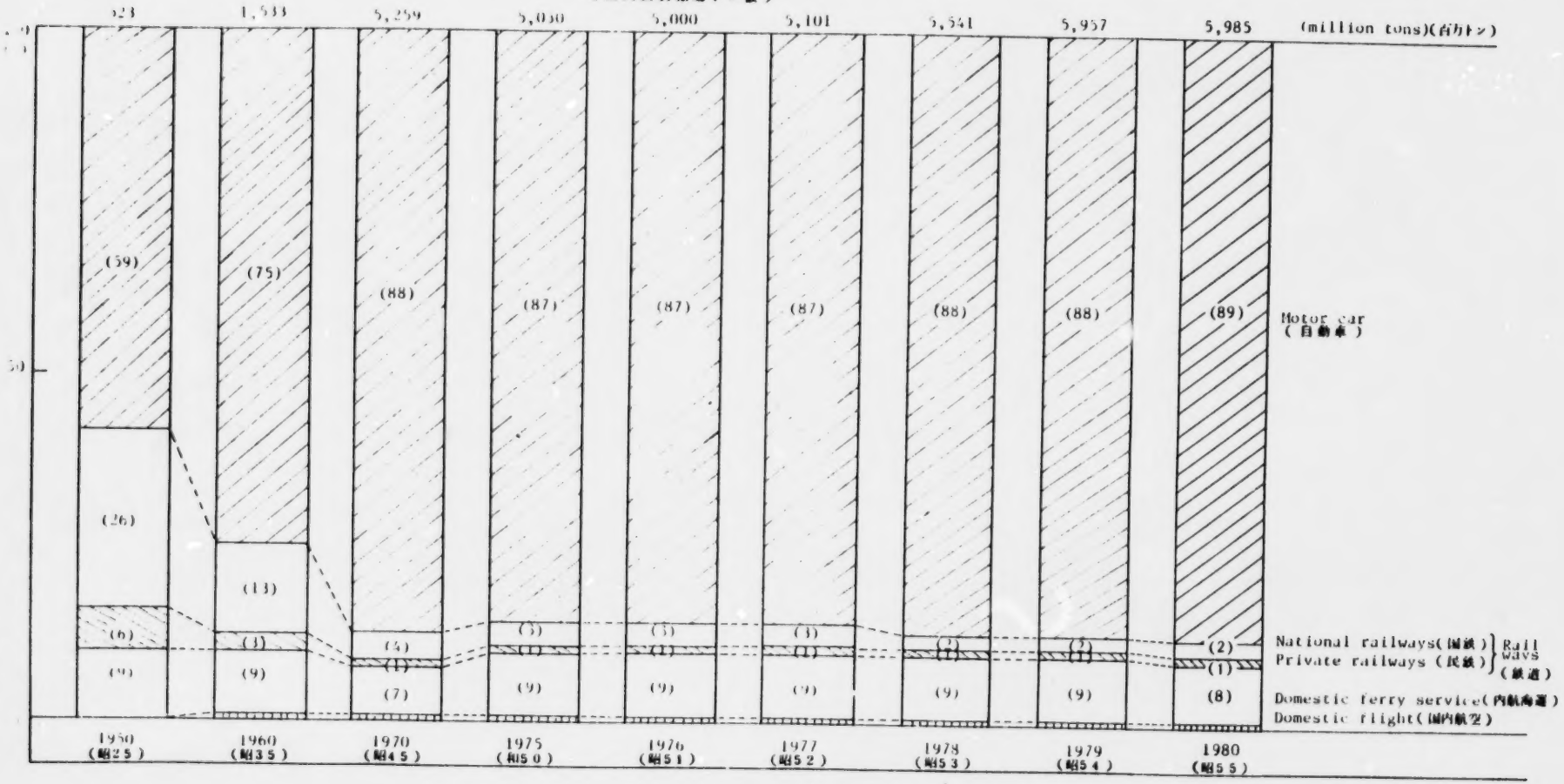
1. Freight（貨物）

Year 年度	Domestic Freight Transport Tonnage (Unit: Million tons) 国内貨物輸送トン数 単位：百万トン							Domestic Freight Transport Ton-Kilometer (Unit: 100 million ton kilometers) 国内貨物輸送トンキロ 単位：億トンキロ							Transport Shares (%) 輸送分担比							
			Railway 鉄道							Railway 鉄道					Tonnage トン数				Ton-Kilometer トンキロ			
	Total 計	Motor Cars 自動車	Total 計	National Railways 国鉄	Private Railways 民鉄	Domestic Ferry Service 内航海運	Domestic Flight 国内航空	Total 計	Motor Cars 自動車	Total 計	National Railways 国鉄	Private Railways 民鉄	Domestic Ferry Service 内航海運	Domestic Flight 国内航空	Motor Cars 自動車	Railway 鉄道	Domestic Ferry Service 内航海運	Domestic Flight 国内航空	Motor Cars 自動車	Railway 鉄道	Domestic Ferry Service 内航海運	Domestic Flight 国内航空
'50	523	309	165	136	29	49	-	647	54	338	333	5	255	-	59	31	9	-	8	52	39	-
'60	1,533	1,156	238	195	43	139	0.009	1,389	208	545	536	9	636	0.06	75	16	1	0	15	39	46	0
'70	5,259	4,626	256	199	57	377	0.116	3,506	1,359	634	624	10	1,512	0.74	88	5	7	0	39	18	43	0
'75	5,030	4,393	185	142	43	452	0.192	3,609	1,297	474	466	8	1,836	1.52	87	4	9	0	36	13	51	0
'76	5,000	4,356	186	141	45	458	0.203	3,734	1,326	463	455	8	1,943	1.60	87	4	9	0	36	12	52	0
'77	5,101	4,456	175	132	43	470	0.229	3,869	1,431	413	406	7	2,023	1.83	88	3	9	0	37	11	52	0
'78	5,541	4,860	178	133	45	503	0.268	4,095	1,561	412	406	8	2,120	2.24	88	3	9	0	38	10	52	0
'79	5,957	5,258	184	136	48	515	0.315	4,421	1,729	431	423	8	2,258	2.73	88	3	9	0	39	10	51	0
'80	5,985	5,318	167	122	45	500	0.329	4,391	1,789	377	370	7	2,222	2.81	89	3	8	0	41	9	50	0

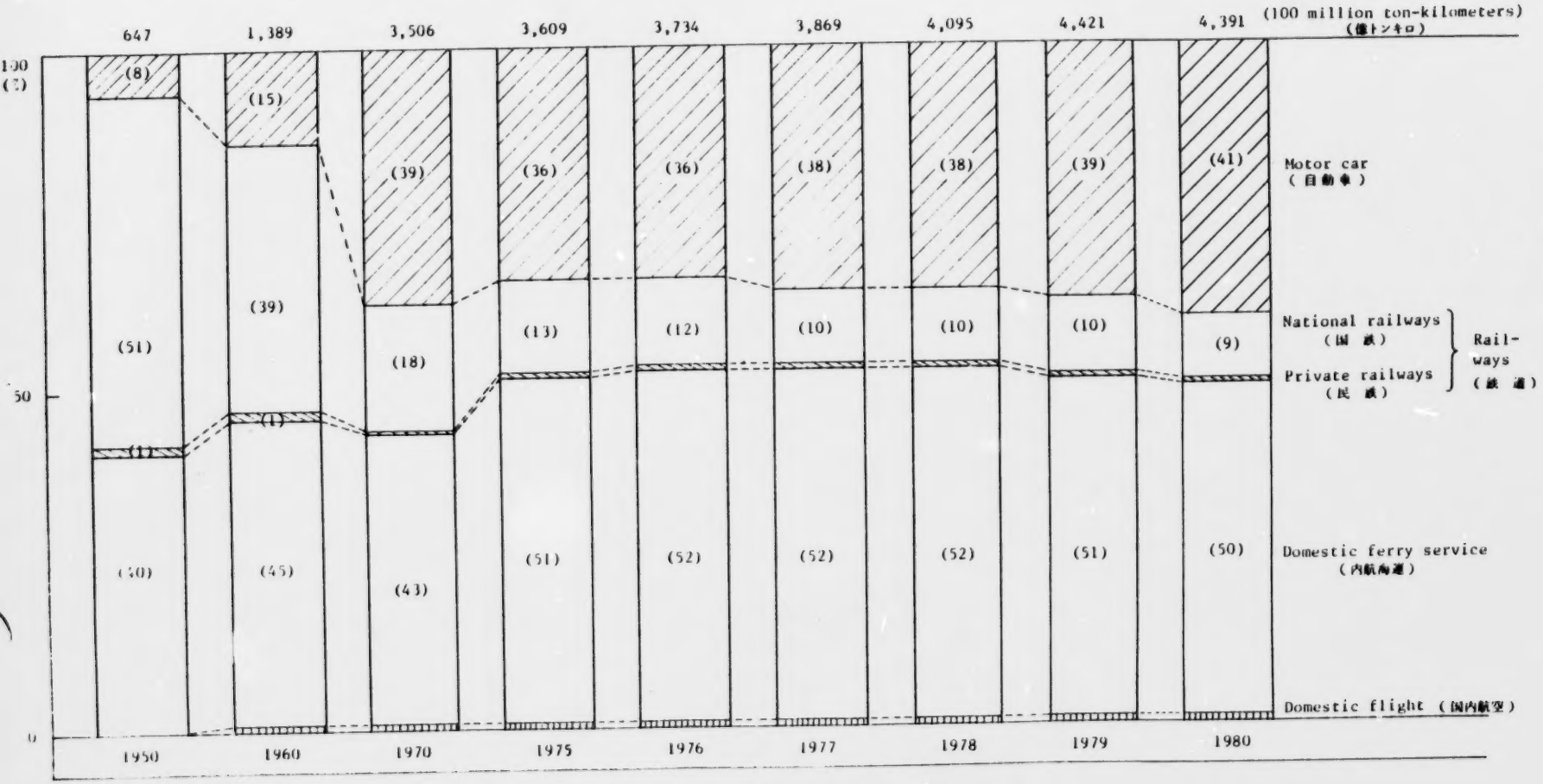
2. Passenger（旅客）

Year 年度	Passengers Carried (Millions) 輸送人員 百万人							Passenger-Kilometers 輸送人キロ (100 million passenger-kilometers) 億人キロ							Transport Shares (%) 輸送分担比			
		Motor Cars 自動車		Railway 鉄道					Motor Cars 自動車		Railway 鉄道				Passengers 人員		Passenger-Kilometers 人キロ	
	Total 計	Buses バス	Passenger Cars 乗用車	National Railways 国鉄	Private Railways 民鉄	Domestic Ferry Service 内航海運	Domestic Flight 国内航空	Total 計	Buses バス	Passenger Cars 乗用車	National Railways 国鉄	Private Railways 民鉄	Domestic Ferry Service 内航海運	Domestic Flight 国内航空	Motor Cars 自動車	Railway 鉄道	Motor Cars 自動車	Railway 鉄道
'50	9,910	1,393	122	3,001	5,297	97	-	1,172	83	7	691	365	26	-	15	85	8	92
'60	20,291	6,291	1,610	5,124	7,166	99	1.26	2,433	440	115	1,240	604	27	7	39	61	23	77
'70	40,606	11,812	12,221	6,534	9,850	174	15.46	5,871	1,029	1,813	1,897	991	48	93	59	41	50	50
'75	46,195	10,731	17,681	7,048	10,540	170	25.47	7,107	1,101	2,508	2,153	1,085	69	191	62	38	53	47
'76	46,684	10,231	18,679	7,189	10,402	164	28.26	7,095	987	2,645	2,107	1,088	67	201	62	38	53	47
'77	47,567	10,189	19,416	7,068	10,699	162	32.90	7,110	1,046	2,640	1,997	1,126	65	236	62	37	52	44
'78	49,363	9,964	21,446	6,997	10,763	162	37.12	7,474	1,070	2,960	1,958	1,153	64	269	64	36	54	42
'79	51,417	9,967	23,405	6,931	10,907	166	41.36	7,773	1,083	3,179	1,947	1,178	64	302	65	35	55	40
'80	51,720	9,901	23,612	6,825	11,180	160	40.43	7,820	1,104	3,213	1,931	1,214	61	297	65	35	55	40

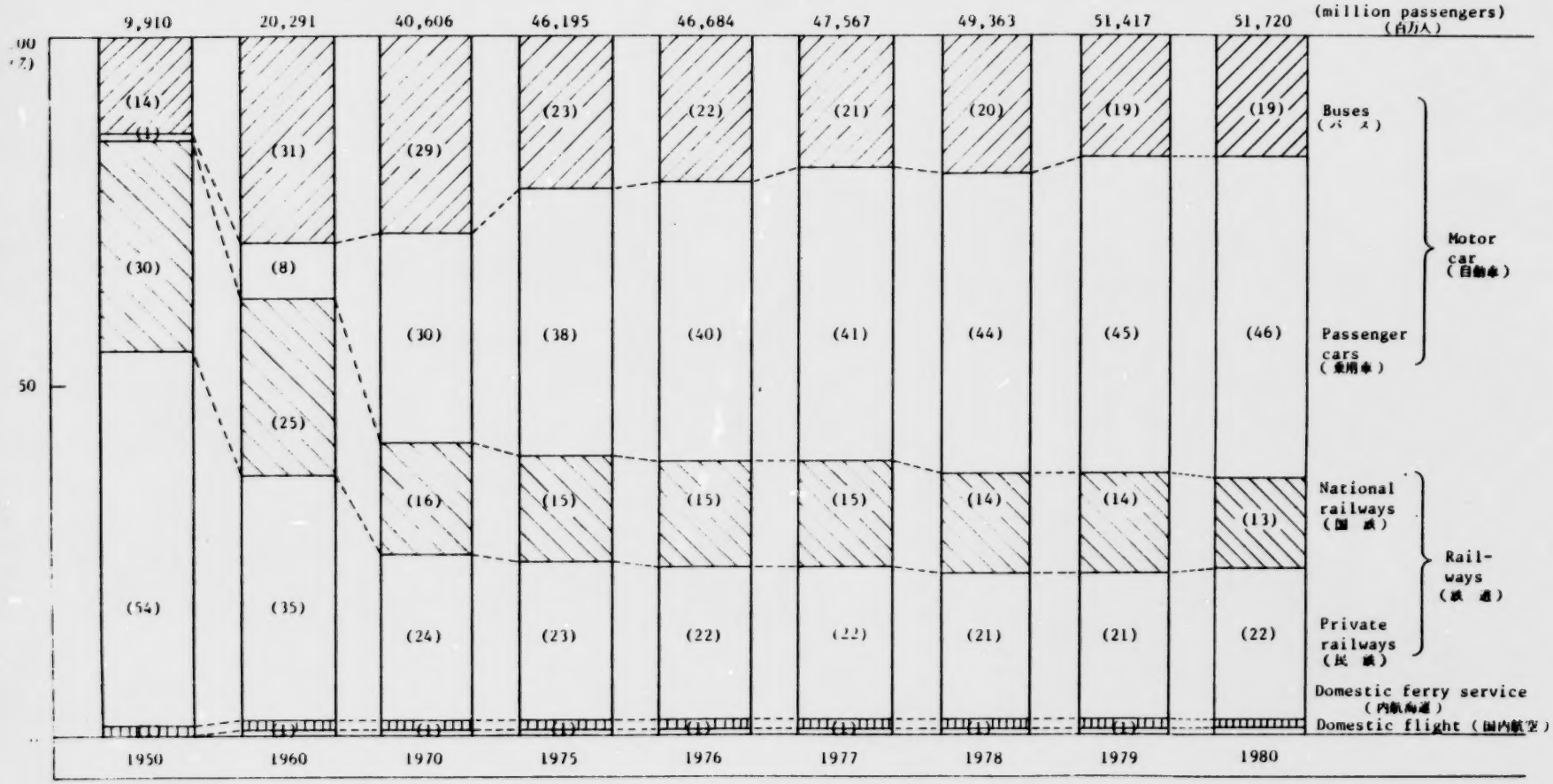
I-(1) Transition of the Traffic Volume by Various Modes of Transport
(輸送機関別輸送量の推移)
(Statistical Data of District Land Transport Bureau)
(陸運統計要覧による)
Domestic Freight Transport Tonnage
(国内貨物輸送トン数)



1-(2) Transition of the Traffic Volume by Various Modes of Transport
(輸送機関別輸送量の推移)
(Statistical Data of District Land Transport Bureau)
(陸運統計要覧による)
Domestic Freight Transport Ton-Kilometers
(国内貨物輸送トンキロ)



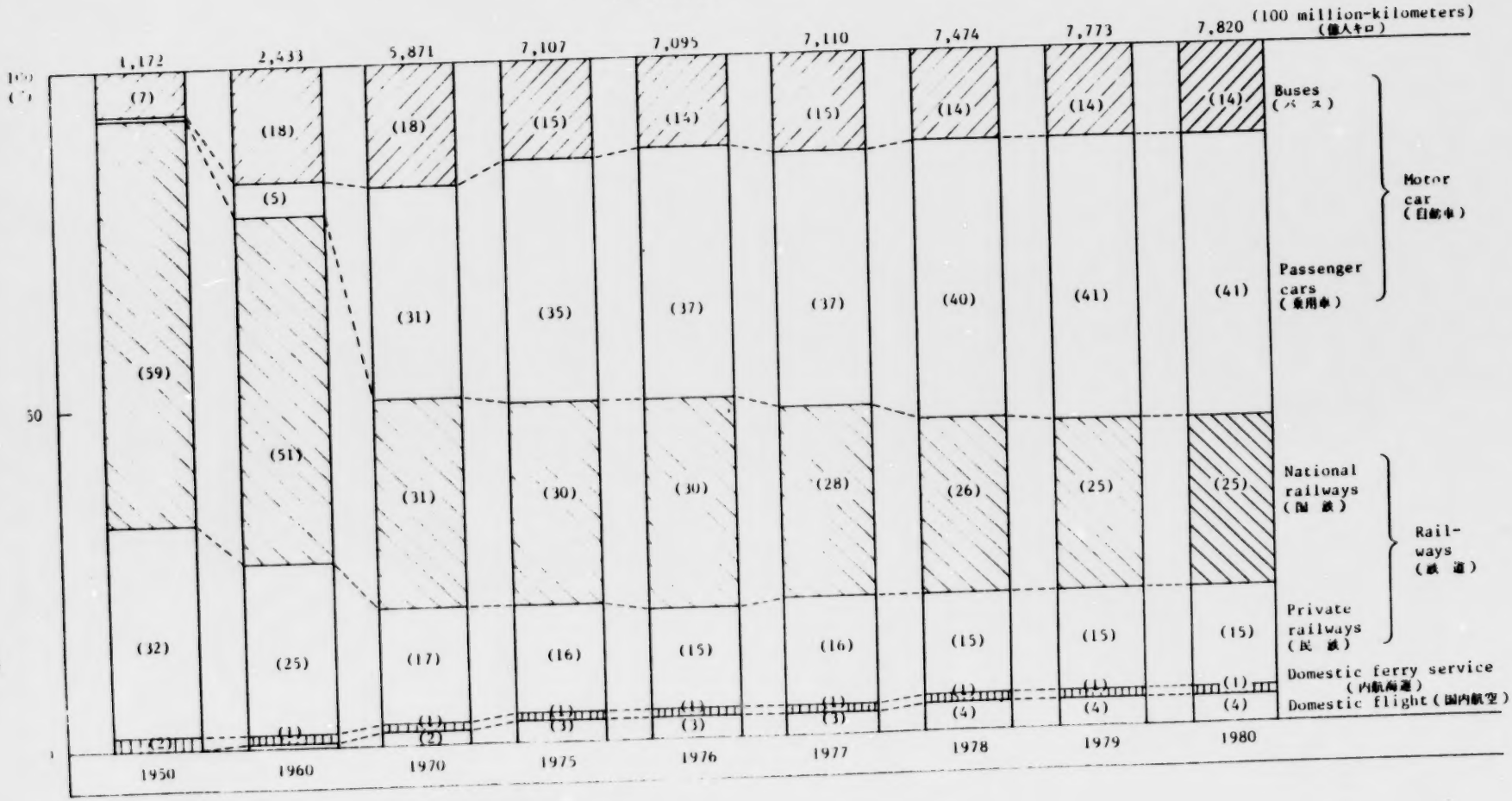
I-(3) Transition of the Traffic Volume by Various Modes of Transport
(輸送機関別輸送量の推移)
(Statistical Data of District Land Transport Bureau)
(陸運統計要覧による)
Passengers Carried
(輸送人員)



1-(4) Transition of the Traffic Volume by Various Modes of Transport
(輸送機関別輸送量の推移)

(Statistical Data of District Land Transport Bureau)
(陸運統計要覧による)

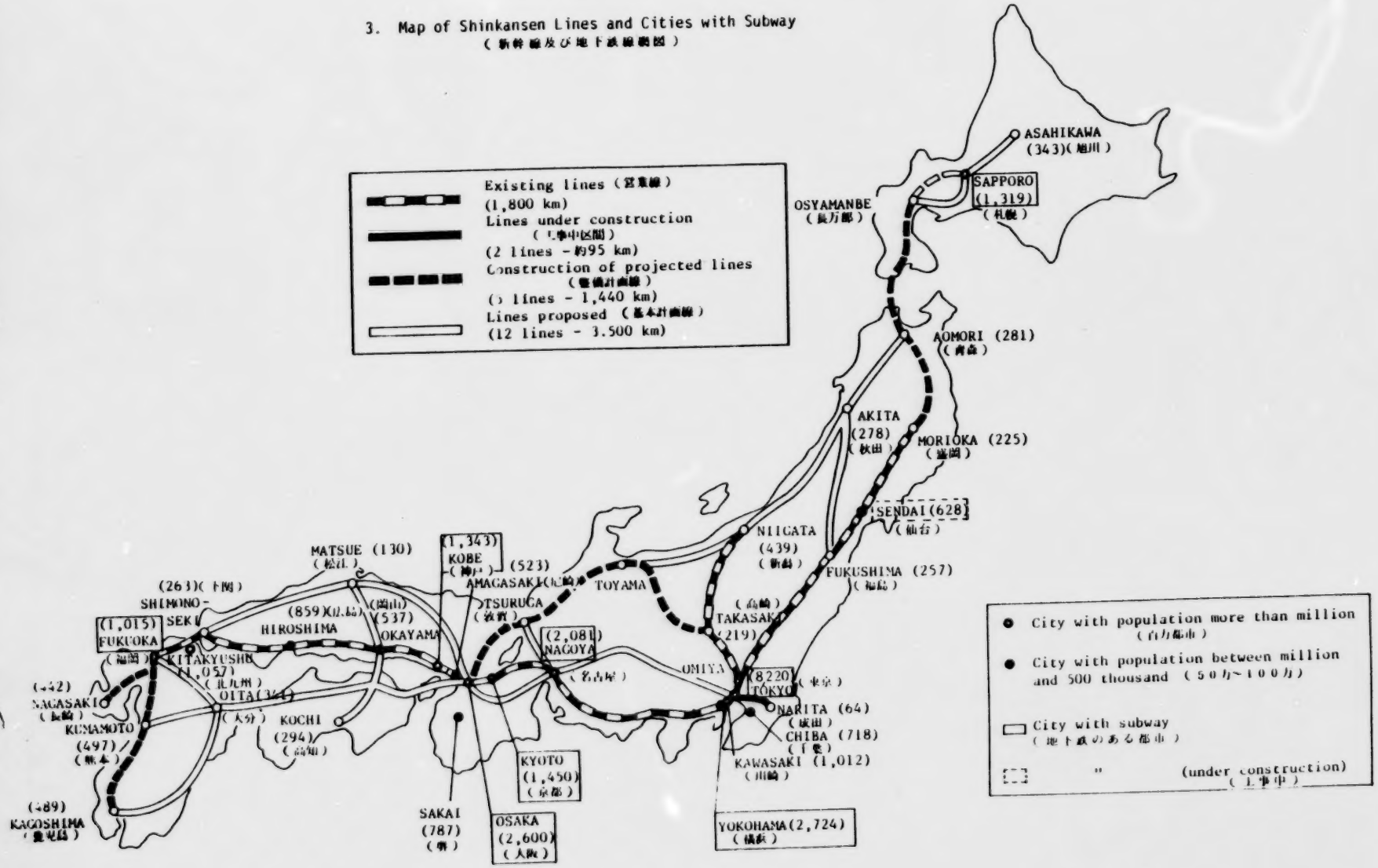
Passenger-kilometers Carried
(輸送人キロ)



2. Present State of Railway Service
（鉄道事業の現況）

Year (年度)	Kinds of Trains (区分)	Route Length・Station Numbers, etc. (営業キロ・駅数等)						Number of Rolling Stock (保有車両数)					
		Route Length (Km) (営業キロ)	Station Numbers (駅の数)	Employees (職員の数)	Freight Car-km (貨物車キロ) (thousands) (千)	Passengers Car-km (旅客車キロ) (thousands) (千)	Electrified Kilometer (Km) (電化キロ)	Steam Locomotive (蒸気機関車)	Electric Locomotive (電気機関車)	Diesel Locomotive (ディーゼル機関車)	Passenger car (客車)	Freight car (貨車)	Total (計)
'55	National (国鉄)	20,093.1	4,572	445,637	4,165,273	1,616,721	1,961	4,897	522	6	14,972	106,223	126,620
	Private (民鉄)	7,578	6,982	125,624	99,992	814,220	-	259	267	110	11,020	10,251	21,907
'60	National	20,754.0	5,160	462,436	5,272,920	2,966,220	4,228	3,164	1,311	469	23,155	139,628	167,727
	Private	7,128	6,479	135,494	102,313	1,312,976	5,893	86	323	207	15,488	9,039	25,143
'70	National	20,890.4	5,224	459,677	5,447,070	3,714,093	6,020	1,601	1,810	1,266	26,440	147,351	178,468
	Private	6,214	5,082	114,744	86,124	1,578,872	5,383	27	316	198	15,760	4,730	21,031
'75	National	21,271.9	5,286	430,051	4,088,084	4,124,542	7,628	15	2,051	2,203	28,440	120,597	153,306
	Private	5,594	4,466	105,872	58,292	1,754,686	4,902	4	227	206	16,443	2,825	19,705
'76	National	21,276.1	5,290	429,216	4,039,860	4,256,833	7,813	15	2,067	2,190	28,757	115,018	148,047
	Private	5,573	4,382	103,780	58,796	1,783,704	4,918	6	222	203	16,759	2,629	19,819
'77	National	21,306.5	5,293	428,928	3,869,294	4,296,238	7,813	15	2,049	2,207	28,904	109,890	143,065
	Private	5,604	4,361	102,669	65,834	1,834,424	4,929	5	217	207	17,064	2,422	19,915
'78	National	21,306.9	5,294	426,697	3,578,819	4,252,263	8,032	5	1,978	2,160	29,047	101,042	134,232
	Private	5,576	4,242	101,489	54,709	1,866,127	4,901	5	211	203	17,256	2,247	19,922
'79	National	21,322.1	5,296	420,815	3,441,281	4,322,869	8,279	5	1,936	2,125	29,219	99,846	133,131
	Private	5,609	4,263	101,468	54,676	1,915,474	4,924	6	210	206	17,703	2,196	20,321
'80	National	21,321.7	5,296	413,594	3,076,451	4,254,046	8,414	5	1,856	2,109	28,910	99,562	132,442
	Private	5,594	4,222	100,806	50,350	1,957,442	4,907	6	209	201	18,069	2,063	20,548

3. Map of Shinkansen Lines and Cities with Subway
（新幹線及び地下鉄線網図）



4. Outline of Shinkansen Lines
（新幹線の概要）

Item（項目） \ Section（区分）	In Service（営業中）					Under Construction（工事中）
	Tokyo - Shin Osaka（東京 - 新大阪）	Shin Osaka - Okayama（新大阪 - 岡山）	Okayama - Hakata（岡山 - 博多）	Omiya - Niigata（大宮 - 新潟）	Omiya - Morioka（大宮 - 盛岡）	Tokyo - Omiya（東京 - 大宮）
Route length（営業キロ）	515 km	161 km	393 km	270 km	465 km	31 km
Tunnels（トンネル）	69 km (13%)	58 km (36%)	223 km (57%)	106 km (39%)	115 km (23%)	
Bridges（橋　梁）	57 km (11%)	20 km (12%)	31 km (8%)	30 km (11%)	78 km (16%)	
Time required（所要時分）	3 hr 10 min	58 min	2 hr 24 min	1 hr 30 min	3 hr 17 min	20 min
Maximum speed（最高速度）	210 km/h					
Minimum curve radius（最小曲線半径）	2,500 m	4,000 m				
Maximum grade（最急こう配）	20/1,000	15/1,000				
Minimum longitudinal curve radius（最曲線半径）	10,000 m	15,000 m				
Construction gauge（建築限界）	Height: 7,700 mm（高さ）　Width: 4,400 mm（幅）					
Rolling stock gauge（車両限界）	Height: 5,450 mm（高さ）　Width: 3,400 mm（幅）					
Rail（レール重量）	60.8 kg/m 1,500 m long-welded rails（長尺レール）					
Track gauge（軌　間）	1,435 mm (48'1/2")					
Formation width（路行基面の幅）	10.7 m	11.6 m	11.0 m	11.6 m		
Distance between track centers（軌道中心間隔）	4.2 m	4.3 m				
Power transmitting system（送電線）	154 kV or 77 kV 2 lines	275 kV or 220 kV 2 lines		275 kV 2 lines		
Feeding system（き電方式）	A.C. 25 kV 60 Hz Single phase（単相） booster-transformer（BTき電）	A.C. 25 kV 60 Hz Single phase（単相） auto-transformer（ATき電）		A.C. 25 kV 50 Hz Single phase（単相） auto-transformer（ATき電）		
Catenary system（電車線方式）	Composite compound	Heavy compound				
Train control（列車制御装置）	ATC (Automatic Train Control)（自動列車制御装置） CTC (Centralized Traffic Control)（列車集中制御装置） COMTRAC (Computer-aided Traffic Control)（計算機による列車制御装置）					
Construction period（工　期）	5-1/2 years	5 years	5 years	9 years (Omiya-Morioka)	9 years	13 years
Construction cost（建設費）(billion yen)（10億円）	380	224	718	1,686	2801	
Opening date（開業年次）	October 1, 1964（昭39. 10. 1）	March 15, 1972（昭47. 3. 15）	March 10, 1975（昭50. 3. 10）	Nov. 15, 1982（昭57. 11. 15）	June 23, 1982（昭57. 6. 23）	1986

4-(1) Operating Results of Tokaido and Sanyo Shinkansen Lines

（東海道・山陽新幹線の営業収支実績の推移）

Item (項目) \ Year (年)	'64	'65	'66	'67	'68	'69	'70	'71	'72 (Note 1) (注)	'73	'74	'75 (Note 2) (注)	'76	'77	'78	'79	'80	'81
Passengers carried (輸送人員) (Millions) (百万人)	11.0	31.0	43.8	55.3	65.9	71.6	84.6	85.4	109.9	128.1	133.2	157.2	143.5	126.8	123.7	123.8	125.6	125.6
Revenues (収入) (Billion Yen) (10億円)	19.4	55.0	89.2	109.8	127.0	164.4	208.6	198.9	251.3	290.3	325.6	477.9	546.7	615.9	652.6	698.9	728.8	788.9
Expenses (支出) (Billion Yen) (10億円)	27.2	67.8	72.8	75.2	77.7	85.7	91.1	90.6	125.1	134.9	168.9	296.0	330.7	370.5	374.3	399.1	430.5	446.6
Balance (収支) (Billion Yen) (10億円)	Δ7.8	Δ12.8	16.4	34.6	49.3	78.7	117.5	108.3	126.2	155.4	156.7	181.9	216.0	245.4	278.3	299.8	298.3	342.3

(Note 1) In March 1972, Sanyo Shinkansen (Shin Osaka - Okayama) was opened.

(注) 昭和47年3月 山陽新幹線（新大阪・岡山）開業

(Note 2) In March 1975, Sanyo Shinkansen (Okayama - Hakata) was opened.

(注) 昭和50年3月 山陽新幹線（岡山・博多）開業

5. Passenger Traffic Volume by Various Modes of Transport in Three Major Urban Traffic Zones

（ 大都市交通圏における交通機関別旅客輸送量 ）

1. Metropolitan (Tokyo) Traffic Zone
（都市交通圏）

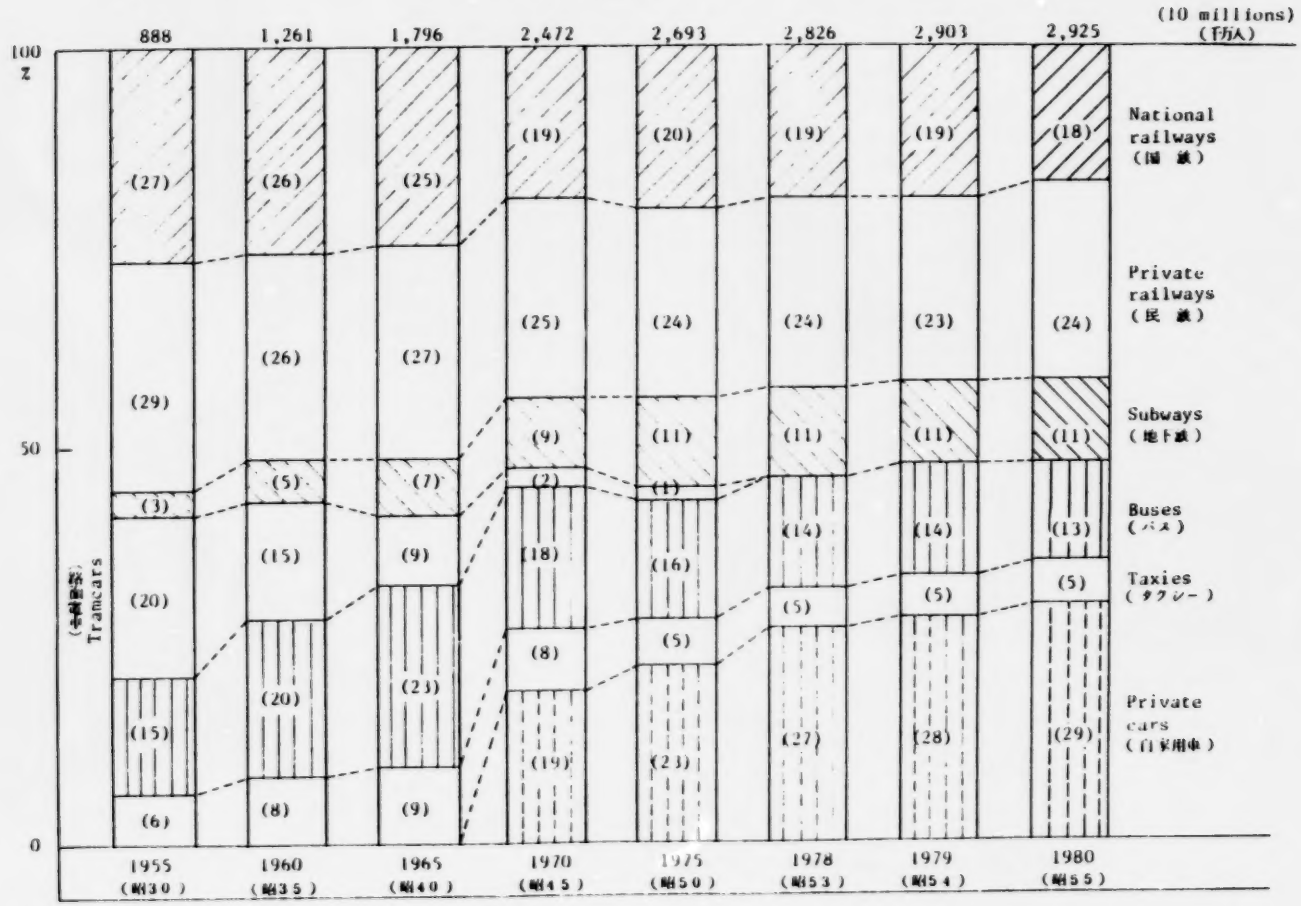
(Unit : 10 million persons)
（単位：千万人）

Year (年)	National Railways (国鉄)		Private Railways (民鉄)		Subways (地下鉄)		Tram Cars (路面電車)		Buses (バス)		Taxies (タクシー)		Private Cars (自家用自動車)		Total (計)	
	Traffic Volume (輸送量)	%	Traffic Volume (輸送量)	%	Traffic Volume (輸送量)	%	Traffic Volume (輸送量)	%	Traffic Volume (輸送量)	%	Traffic Volume (輸送量)	%	Traffic Volume (輸送量)	%	Traffic Volume (輸送量)	%
'55	186	36	117	23	15	3	84	16	79	15	34	7	-	-	515	>100
'60	259	35	175	23	32	4	84	11	144	19	57	8	-	-	751	
'65	347	33	256	24	75	7	68	6	219	21	98	9	-	-	1,063	
'70	360	25	320	22	133	9	18	1	255	17	116	8	256	18	1,458	
'75	407	26	359	23	176	11	5	0	251	16	82	5	307	19	1,587	
'78	411	25	380	23	185	11	4	0	233	14	91	5	358	22	1,662	
'79	411	24	386	23	190	11	4	0	229	14	91	5	390	23	1,701	
'80	394	23	393	23	202	12	4	0	226	14	89	5	397	23	1,705	
2. Chukyo (Nagoya) Traffic Zone （中京交通圏）																
'55	7	9	25	32	-	-	28	35	14	18	5	6	-	-	79	>100
'60	9	8	33	28	2	2	25	21	40	34	9	7	-	-	118	
'65	13	7	45	26	8	5	21	12	73	41	16	9	-	-	176	
'70	17	7	50	20	14	5	10	4	62	24	20	8	82	32	255	
'75	20	7	44	16	26	8	1	0	58	19	14	5	140	45	308	
'78	18	5	47	14	28	8	1	0	52	15	15	5	178	53	339	
'79	18	5	47	13	29	8	1	0	51	15	15	4	197	55	358	
'80	19	5	49	14	30	8	1	0	49	14	15	4	201	55	364	
3. Keihanshin (Kyoto・Osaka・Kobe) Traffic Zone （京阪神交通圏）																
'55	44	15	113	39	15	5	68	23	38	13	16	5	-	-	294	>100
'60	65	17	126	32	23	6	81	21	68	17	29	7	-	-	392	
'65	98	17	183	33	37	7	67	12	118	21	54	10	-	-	557	
'70	106	14	245	32	77	10	21	3	124	16	57	8	129	17	759	
'75	115	14	237	30	85	11	10	1	121	15	44	6	186	23	798	
'78	112	13	239	29	87	10	5	1	113	14	49	6	220	27	825	
'79	114	14	241	29	88	10	4	0	112	13	49	6	236	28	844	
'80	109	13	245	29	92	11	3	0	113	13	48	5	246	29	856	
4. Total （計）																
'55	237	27	255	29	30	3	180	20	131	15	55	6	-	-	888	>100
'60	333	26	334	26	57	5	190	15	252	20	95	8	-	-	1,261	
'65	458	25	484	27	120	7	156	9	410	23	168	9	-	-	1,796	
'70	483	19	615	25	224	9	49	2	441	18	193	8	467	19	2,472	
'75	542	20	645	24	287	11	16	1	430	16	140	5	633	23	2,693	
'78	541	19	666	24	300	11	10	0	398	14	155	5	756	27	2,826	
'79	543	19	674	23	307	11	9	0	392	14	155	5	823	28	2,903	
'80	522	18	687	24	324	11	8	0	388	13	152	5	844	29	2,925	

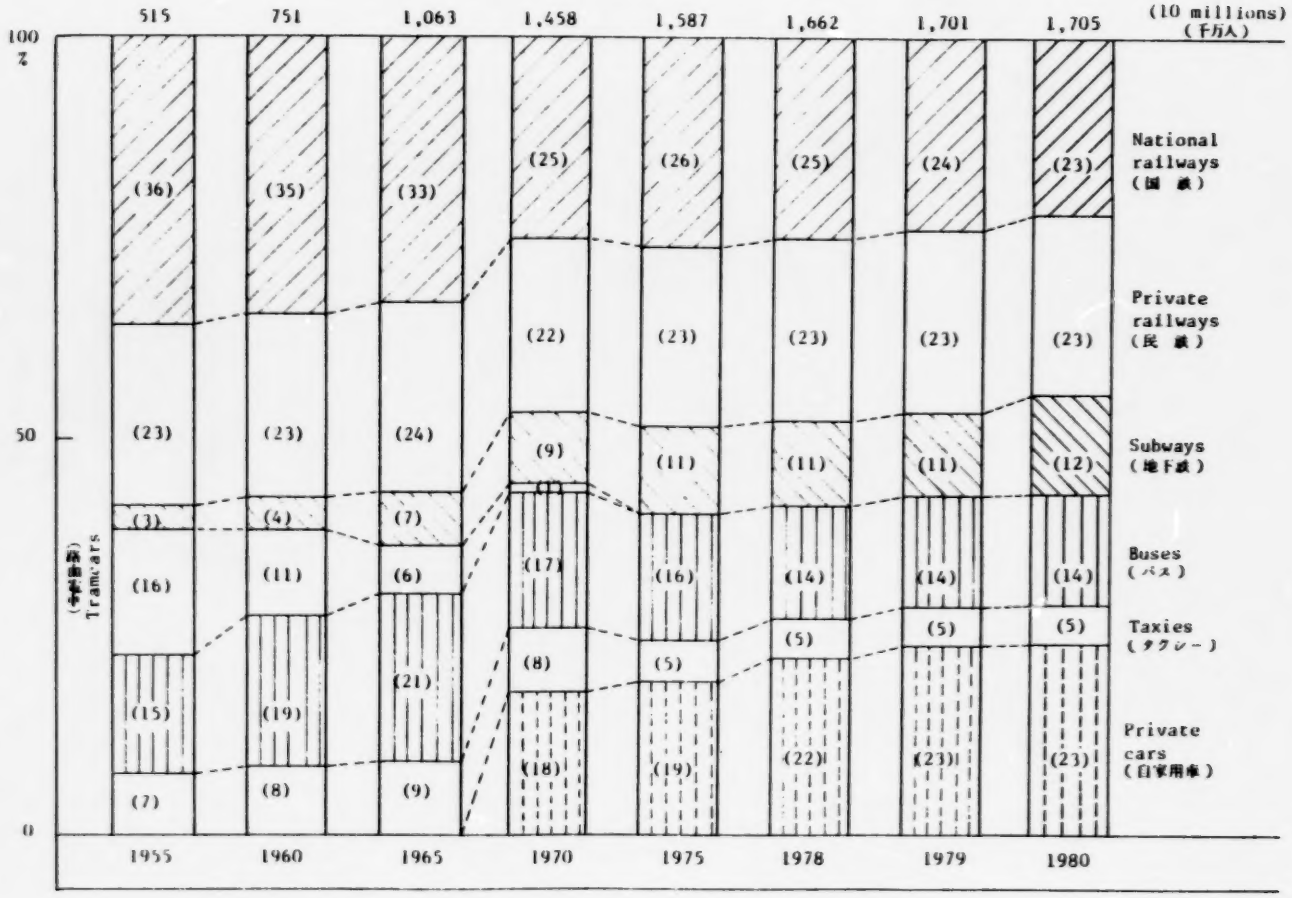
(Note) '55, '60, '65 do not include the traffic volume of private cars
(注) 昭30, 35, 40年は自家用自動車の輸送量は含まれない

(Urban Traffic Year Book of 1982)
（都市交通年報 昭57年版による）

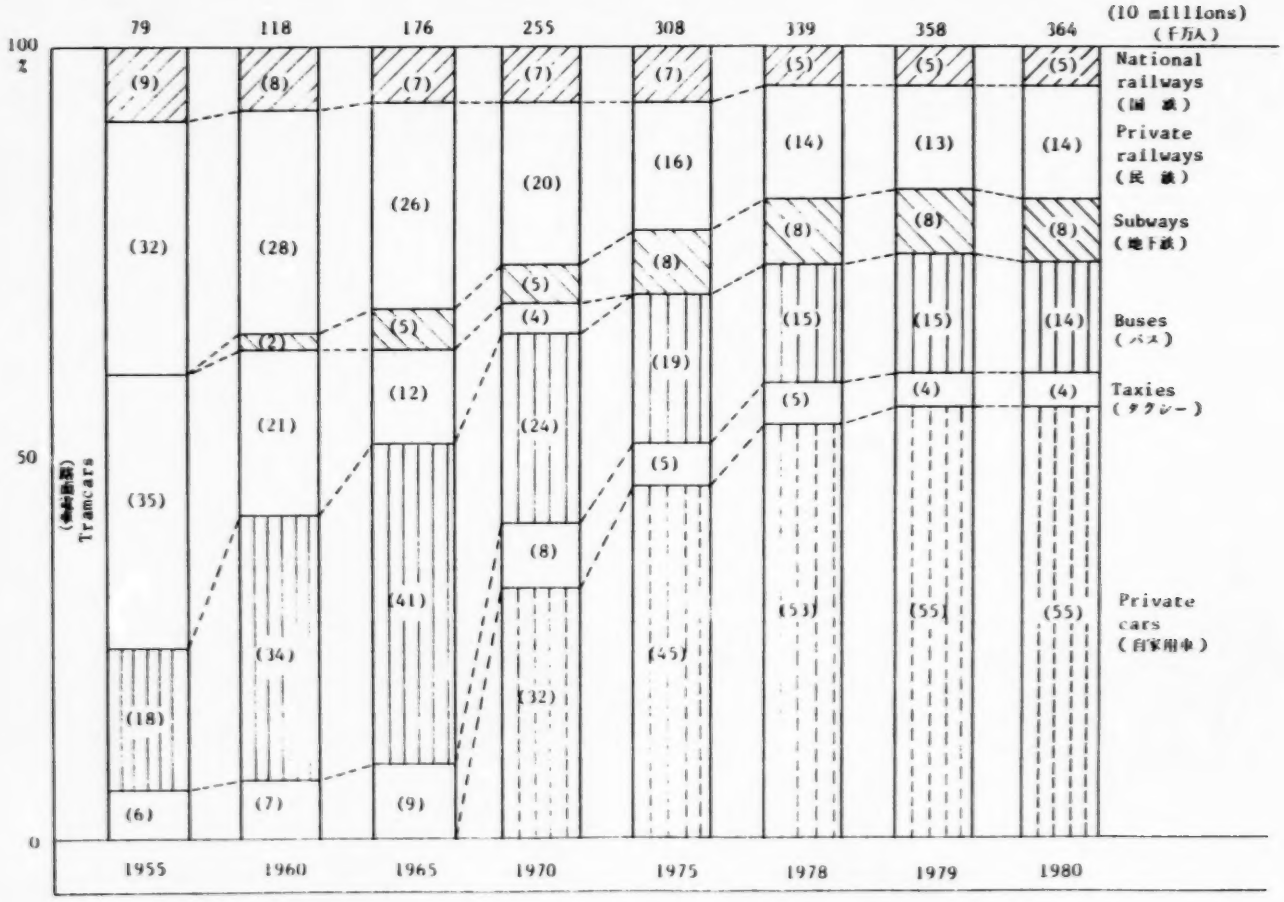
5-(1) Transition of Traffic Shares of Passengers Carried by Various Modes of Transport
(交通機関別旅客輸送人員分担率の推移)
(Three Major Urban Traffic Zones Total)
(三大都市交通圏合計)



5-(2) Transition of Traffic Shares of Passengers Carried by Various Modes of Transport
（交通機関別旅客輸送人員分担率の推移）
(Metropolitan (Tokyo) Traffic Zone)
（首都交通圏）



5-(3) Transition of Traffic Shares of Passengers Carried by Various Modes of Transport
（交通機関別旅客輸送人員分担率の推移）
(Chukyo (Nagoya) Traffic Zone)
（中京交通圏）

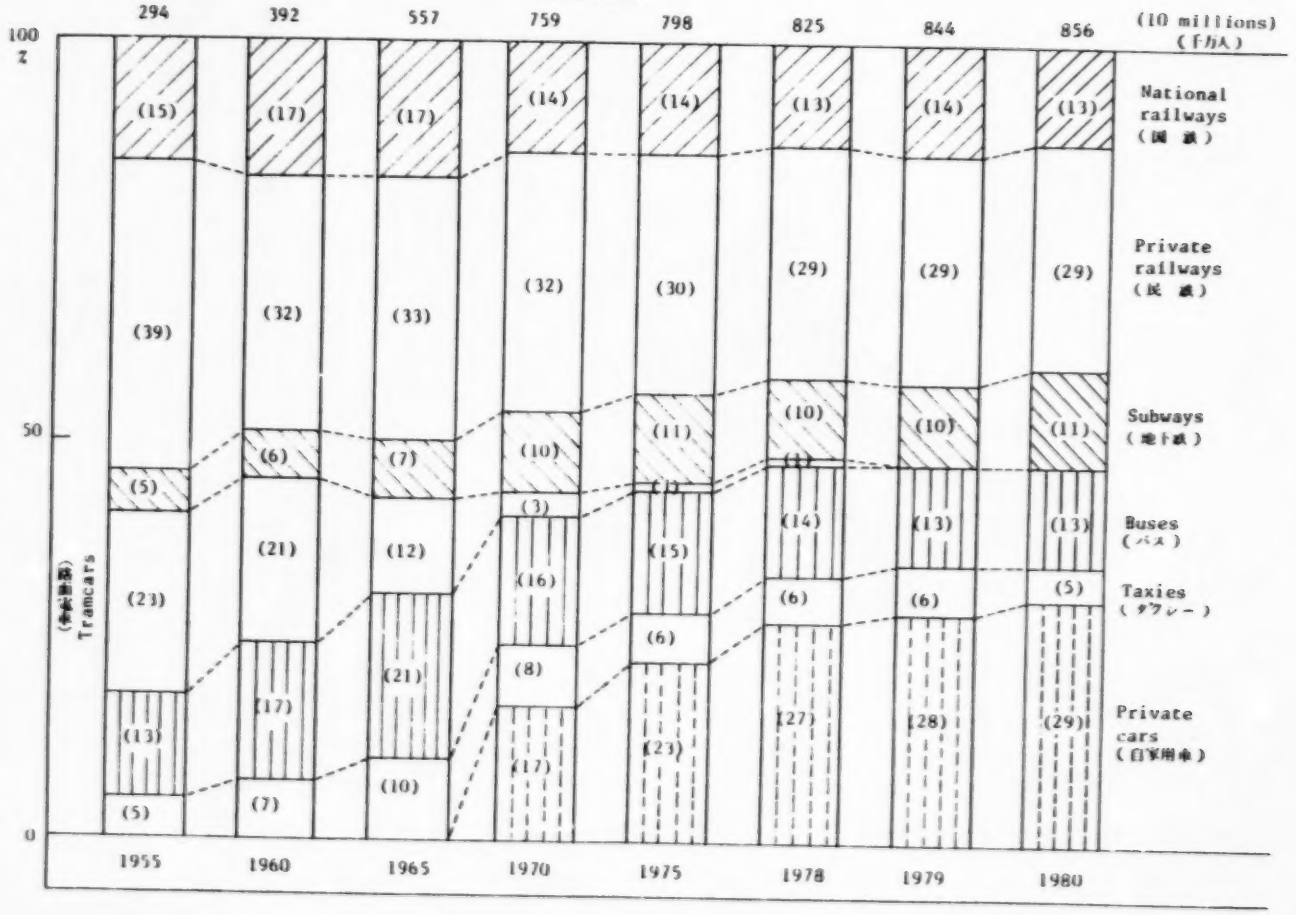


5-(4) Transition of Traffic Shares of Passengers Carried by Various Modes of Transport

（交通機関別旅客輸送人員分担率の推移）

(Keihanshin (Kyoto・Osaka・Kobe) Traffic Zone)

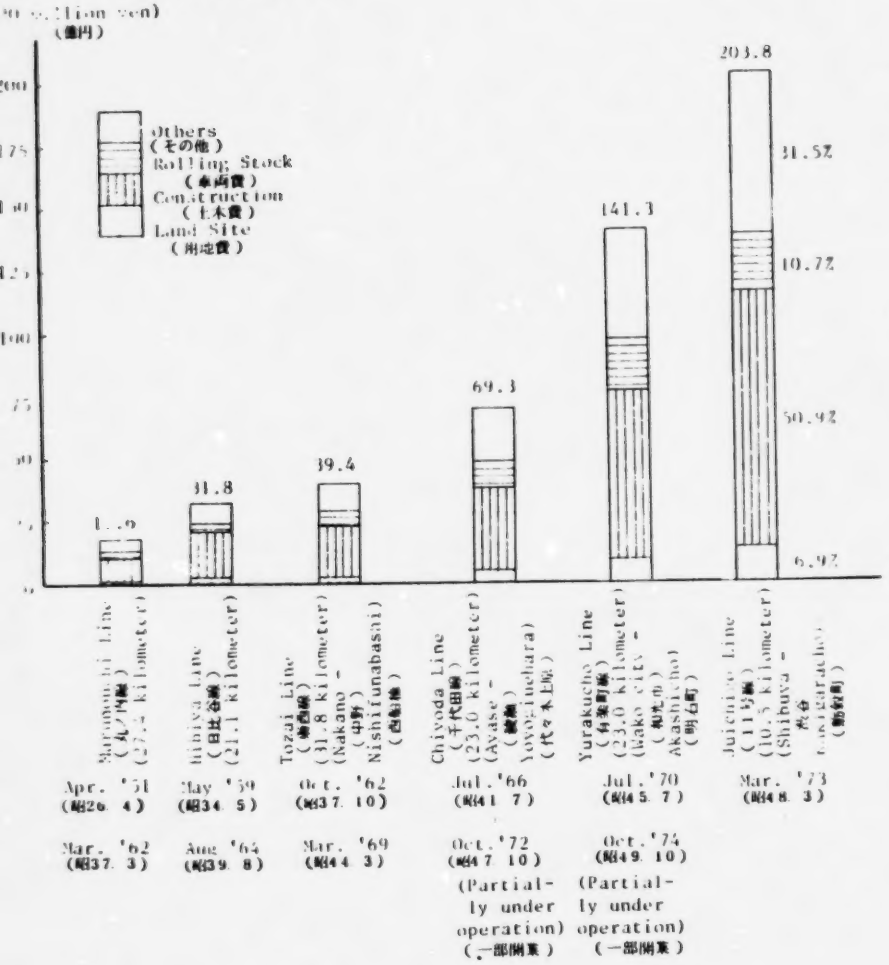
（京阪神交通圏）



6. Outline of Subways (As of August 1, 1981)
（地下鉄の概要）　　（昭56.8.1現在）

Area (区域)	Operator (事業者)	Under Operation (営業中)		Under Construction (工事中)		Scheduled Construction (着手予定)	
		No. of Routes (路線数)	Route Length (Km) (営業キロ)	No. of Routes (路線数)	Con-struction Kilometer (Km) (建設キロ)	No. of Routes (路線数)	Con-struction Kilometer (Km) (建設キロ)
Sapporo (札幌)	Sapporo City (札幌市)	2	24.2	1	7.3		
Sendai (仙台)	Sendai City (仙台市)			1	14.4		
Metropolitan Area (首都圏)	Metropolitan High Speed Transportation Corporation (首都高速鉄道交通営団)	7	131.8	3	17.2	2	7.3
	Tokyo-to (東京都)	3	54.9	1	9.2	2	40.3
	Yokohama City (横浜市)	2	11.5	2	10.6	1	1.9
Chukyo (中京)	Nagoya City (名古屋市)	4	51.5	2	10.1		
Kei-Hanshin (京阪神圏)	Kyoto City (京都市)	1	6.6	1	5.1		
	Osaka City (大阪市)	6	86.1	4	12.5	3	9.2
	Kobe City (神戸市)	1	5.7	1	7.5		
Kyushu (九州)	Fukuoka City (福岡市)	1	5.8	2	9.6		
Total (計)		27	378.1	18	101.5	8	58.7

7. Transition of Construction Cost of Subways per Kilometer
（地下鉄キロ当り建設費の推移）



8. Subsidies to Subways
（地下鉄に対する助成制度）

1. Subsidize the amount equivalent to 70% of construction cost in ten year installments, starting from the following year.
（補助対象建設費の額の７０％に相当する金額を翌年度から１０年分割補助する。）

2. The subsidy is shared fifty fifty by the State and local public bodies.
（負担は国と地方公共団体と折半とする）

3. Subsidy Calculation Method
（補助金算定方式）

(1) Construction of a new line
（新線建設）

$$\text{Construction Cost for Subsidy (補助対象建設費)} \left\{ \left(\text{Total Construction Cost (総建設費)} - \text{Overhead (総係費)} \right) \times 0.9 \left(\text{onerous capital ratio (有償資金比率)} \right) \right\} \times 0.7 \text{ (subsidy ratio) (補助率)}$$

(2) Improvement
（改良工事）

$$\text{Construction Cost for Subsidy (補助対象建設費)} \left\{ \left(\text{Total Construction Cost (総建設費)} - \text{Overhead (総係費)} \right) \times 0.9 \left(\text{onerous capital ratio (有償資金比率)} \right) \times \cdots \right\} \times 0.7 \text{ (subsidy ratio) (補助率)}$$

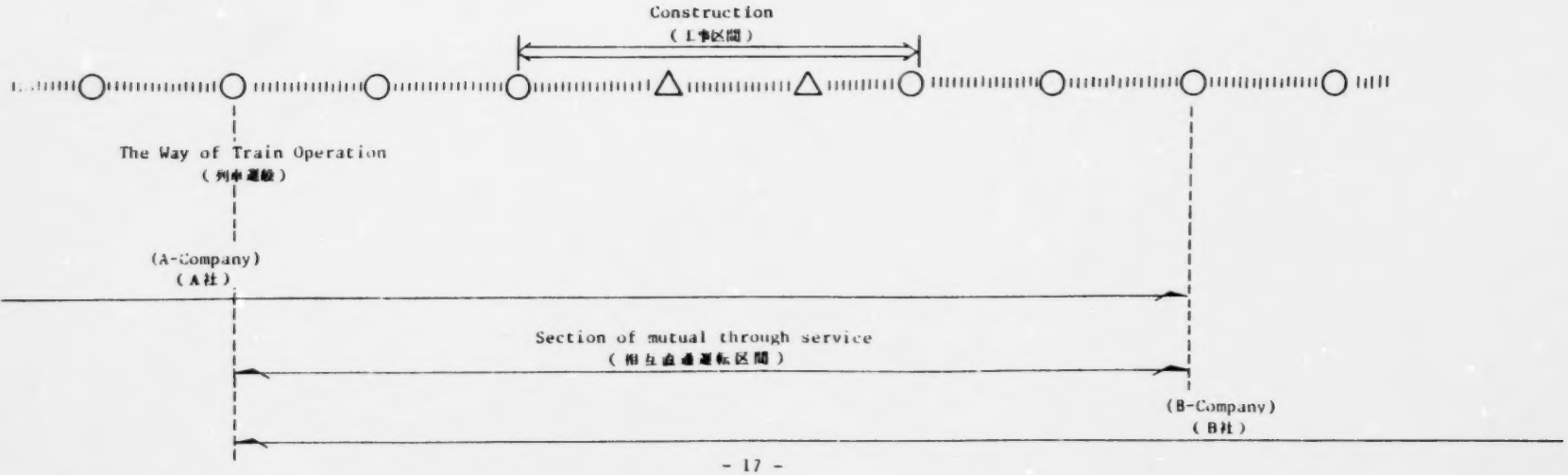
4. Subsidy Ratio
（補助率）

Year (年)	1	2	3	4	5	6	7	8	9	10	Total (計)
State (国)	6	5	4	3	3	3	3	3	3	2	35%
Local Public Body (地方公共団体)	6	5	4	3	3	3	3	3	3	2	35%

9. Mutual Through Service
（相互直通運転）

(1) Before Construction
（工事前）

(2) After Construction
（工事終了後）



10. Outline of Monorail (As of August 1981)

（モノレールの概要）　　（昭56 8 現在）

Classification (区 分)		Under Operation (営業中)				
Type (型式)		Hanging Type (懸垂式)		Straddle Type (跨座式)		
Operator (事業者名)		Shonan Monorail (湘南モノレール)	Tokyo Metropolitan Government (東京都)	Tokyo Monorail (東京モノレール)	Odakyu Electric Railway (小田急電鉄)	Nagoya Railway (名古屋鉄道)
Operation Started (開業)	Year and Month (年月)	March 1970,(昭45 3) July 1971 (昭46.7)	December 1957 (昭3212)	September 1964 (昭39 9)	April 1966 (昭41 4)	March 1962 (昭37.3)
Operating Section (区 間)		Otuna - (大船) Shonan Enoshima (湘南江ノ島)	Ueno Dobutsuen - (上野動物園) Bunen (分園)	Haneda (羽田) - Monorail Hamamatsucho (モノレール浜松町)	Mukogaoka Yuen - (向ケ岡遊園) Mukogaoka Yuen Seimon (向ケ岡遊園正門)	Inuyama Yuen - (犬山遊園) Dobutsuen (動物園)
Route Length (Km) (キロ程)		6.6	0.3	13.0	1.1	1.2
Classification of Single Track or Double Track (単・複線の別)		Single track (単線)	Single track (単線)	Single tracked near terminal stations. Rest is double tracked. (両端駅付近のみ単線・他は複線)	Single track (単線)	Single track (単線)
Number of Rolling Stock (車両数)		16	2	44	2	6
Average seating capacity per Vehicle (person) (一車両平均定員)		104	31	127	120	65
Number of Times Operated per Day (going and Returning) (一日運転回数(往復))		99	Regular (定 期) 7 Irregular (不定期) 56	132	Regular (定 期) 25 Irregular (不定期) 28	17
Headway (運転間隔)	Peak hours (ピーク時) Off peak hours (オフピーク時)	7'30" 15 00"	Irregular Operation (不定期運行)	5'30" 7'00"	Irregular Operation (不定期運行)	Irregular Operation (不定期運行)
Maximum Running Speed (最高運転速度) (Km/h)		75	15	80	40	35
Passengers carried (輸送人員)	1779, 1980 (昭54)(昭55) With commuter passes (定期) (thousand person) (千人)	3,910, 4,154	- -	7,377 7,753	- -	- -
	Without commuter passes (定期外) (thousand person) (千人)	3,711, 3,762	1,058, 1,150	19,029, 18,786	681, 694	987, 928
	Total (計)	7,621, 7,916	1,058, 1,150	26,406 26,539	681, 694	987, 928

Classification (区 分)	Under Operation (営業中)				
Type (型式)	Hanging Type (懸垂式)		Straddle Type (跨座式)		
Operator (事業者名)	Shonan Monorail (湘南モノレール)	Tokyo Metropolitan Government (東京都)	Tokyo Monorail (東京モノレール)	Odakyu Electric Railway (小田急電鉄)	Nagoya Railway (名古屋鉄道)
Construction Cost per Kilometer (one hundred million yen) (キロ当り建設費) (億円)	8	-	16	1.8	4
Minimum Curve Radius in the Main Track (m) (本線最小曲線半径)	50	40	120	40	150
Maximum Grade in the Main Track (0/00) (本線最急こう配)	74	40	60	54	97
Type of Electric Railway (電気鉄道の方式)	1,500 V, D.C.	600 V, D.C.	750 V, D.C.	600 V, D.C.	1,500 V, D.C.
Classification of ATS or ATC (ATS・ATCの別)	ATS	ATS	ATS	ATS	ATS
Installation of Train Radio (列車無線の有無)	Space Wave Radio (空間波無線)	-	Space Wave Radio (空間波無線)	Space Wave Radio (空間波無線)	Inductive Radio (誘導無線)

Classification (区分)		Under Construction (建設線)	Scheduled Construction (建設予定線)		
Type (型式)		Straddle Type (跨座式)	Hanging Type (懸垂式)	——	——
Construction-Operating Body (建設・経営主体)		Kitakyushu High Speed Railway (北九州高速鉄道)	Chiba City Monorail (千葉都市モノレール)	Osaka High Speed Railway (大阪高速鉄道)	Third Sector is scheduled with Okinawa Pref. as main body. (沖縄県を主体とする第三セクターを予定)
Completion Schedule (完成予定)	Year and Month (年月)	April 1983 (昭58 4)	Partial Operation Mar. 1986 (一部開業 昭61 3) Full Operation April 1987 (全線 昭62 4)	Partial Operation Apr. 1985 (一部開業 昭60 4) Full Operation Apr. 1988 (全線 昭63 4)	1989 (昭64)
Operating Section (区間)		Kokura Station - Shiishakomae (小倉駅 - 志井車庫前)	Chuoko - Hoshikuki (中央港 - 星久喜) Chiba St. - Chishirodai (千葉駅 - 千城台)	Osaka Int'l Airport - Hankyu Minami Ibaragi (大阪国際空港 - 阪急南茨木)	Takashima - Toribori (高島 - 鳥堀)
Route Length (Km) (キロ程)		8.7	3.4 + 12.1 } 15.5	13.7	11.1
Classification of Single Track or Double Track (単・複線の別)		Double Track (複線)	Double Track (複線)	Double Track (複線)	-
Number of Rolling Stock (Vehicle) (車両数) (両)		40 (72 in the future) (将来は72両)	364	44	-
Seating Capacity per Vehicle (車両定員) (person) (人)		Head car 114 (先頭中) Middle car 125 (中間中)	Head car 101 (先頭中) Middle car 112 (中間中)	-	-
Headway (運転間隔)	Peak hours (ピーク時)	At time of operation start 6' (1995 3') (開業時6分)	At time of operation start 5'-6' (2005 4'20") (開業時5-6分)	At start time of Parrial Operation 7'30" (一部開業時 7分30秒) Full Operation 6'42" (全線開業時) 6'42"	-
	Off peak hours (オフピーク時)	10'	10'-15'		
Passengers Carried (運送人員) (Person) (人)	Operation Completion Year (整備完了年度)	1995 : 122,300/day (昭70)	2005 : 174,652/day (昭80)	1989 : 104,433/day (昭64)	1990 : 71,751/day (昭65)
	Peak Hours (ピーク時)	10,200/hour	11,415/hour	5,647/hour	-

Classification (区分)		Under Construction (建設線)	Scheduled Construction (建設予定線)		
Type (型式)		Straddle Type (懸垂式)	Hanging Type (懸申式)	——	——
Construction-Operating Body (建設・経営主体)		Kitakyushu High Speed Railway (北九州高速鉄道)	Chiba City Monorail (千葉都市モノレール)	Osaka High Speed Railway (大阪高速鉄道)	Third Sector is scheduled with Okinawa Pref. as main body. (沖縄県を主体とする第三セクターを予定)
Construction Cost (建設費)	Disbursed by Operator (事業者施工分)	31,920 million yen (百万円)	66,305 million yen (百万円)	40,203 million yen (百万円)	34,700 million yen (百万円)
	Public Enterprises, etc. (公共事業等)	27,631	53,708	39,681	28,300
	Total (計)	59,551	120,013	79,884	63,000
	per kilometer (キロ当り)	6,845	7,800	5,831	5,700
Minimum Curve Radius in the Main Track (m) (本線路最小曲線半径)		80	50	-	-
Maximum Grade in the Main Track (0/00) (本線路最急勾配)		40	60	-	-
Type of Electric Railway (電気鉄道の方式)		1,500 V, D.C.	1,500 V, D.C.	-	-
Classification of ATS and ATC (ATS・ATCの別)		ATC	ATC	-	-
Installation of Train Radio (列車無線の有無)		Space Wave Radio (空間波無線)	Space Wave Radio (空間波無線)	-	-

11. Outline of New People Mover System

（新交通システムの概要）

Classification（区　分）		Under Operation（営業中）		Under Construction（建設中）	Construction to be started（着工予定線）		Construction Scheduled（建設予定線）	
Operator（事業者名）		Osaka City（大阪市）	Kobe Shin Kotsu（神戸新交通）	Yamanan（山万）	Tokadai Shinkotsu（鬼花台新交通）	Saitama Shin Toshi Kotsu（埼玉新都市交通）	Under Study mainly by Yokohama City（横浜市を中心に検討中）	Under Study mainly by Ibaragi Pref.（茨城県を中心に検討中）
Type（型　式）		Side-Guided Type（側方案内式）	Side-Guided Type（側方案内式）	Center-Guided Type（中央案内式）	Center-Guided Type（中央案内式）	Side-Guided Type（側方案内式）	Side-Guided Type（側方案内式）	Under study, including Dual Mode Bus System（デュアルモードバスシステムを含めて検討中）
Completion Schedule（完成予定）	Year and Month（年月日）	March 16,1981（昭56 3 16）	Feb. 5, 1981（昭56 2 5）	Partial Operation May 1982（部分開業 昭57 5） Full Operation April 1983（全線開業 昭57 5）	-	Oct. 1982（昭57 10）	-	-
Operating Section（区　間）		Nakafuto - Suminoe Koen（中埠頭 - 住之江公園）	Sannomiya - Minami Koen（三宮 - 南公園）	Yukarigaoka - Koen（ユーカリが丘 - 公園）	Meitetsu Komaki（名鉄小牧） - Tokadai Higashi（鬼花台東）	Omiya - Kohari（大宮 - 小針）	JNR Shinsugita（国鉄新杉田） - Keikyu Kanazawa Hakkei（京急金沢八景）	Tsukuba Univ. Annex Hospital - Hanamuro Bus Center（筑波大学附属病院 - 花室バスセンター）
Route Length (Km)（キロ程）		6.9	6.4	4.2	7.7	12.9	10.0	1.5
Classification of Single or Double Track（単・複線の別）		Double Track（複線）	Double Tracked portion 2.9Km（複線部） Single Track loop portion 3.5Km（単線ループ部）	Single Track（単線）	Double Track（複線）	Double Track 8.3 Km（複線） Single Track 4.6 Km（単線）	Double Track（複線）	Double Track（複線）
Number of Rolling Stock (Vehicle)（車両数／（両））		52 (112 in future)（将来）	78	9	28	60	-	-
Average seating capacity per vehicle（一車両平均定員）(person)（人）		75	75	70	70	75	-	-
Headway（運転時隔）	Peak hours（ピーク時）	3'30" - 2'15"	3'20" - 2'30"	7'	7'30" - 2'40"	7'30"	-	-
	Off peak hours（オフピーク時）	5'	5'	14'	10' - 5'	15'	-	-
Maximum Running Speed（最高運転速度） (Km/h)		50	57	50	50	60	-	-

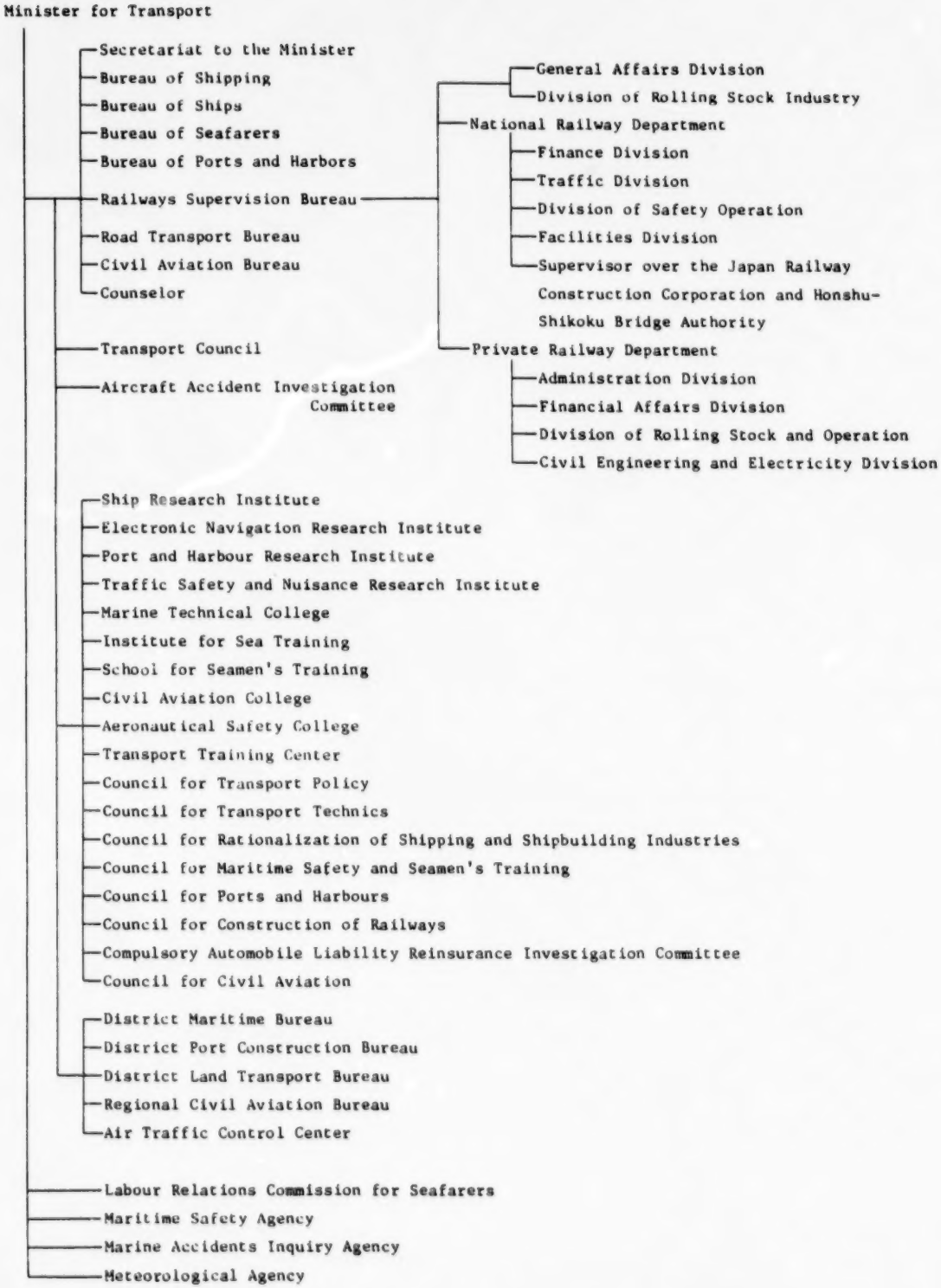
Classification (区 分)		Under Operation (営業中)		Under Construction (建設中)	Construction to be started (着工予定線)		Construction Scheduled (建設予定線)	
Operator (事業者名)		Osaka City (大阪市)	Kobe Shin Kotsu (神戸新交通)	Yamaman (山万)	Tokadai Shinkotsu (鉄花台新交通)	Saitama Shin Toshi Kotsu (埼玉新都市交通)	Under Study mainly by Yokohama City (横浜市を中心に検討中)	Under Study mainly by Ibaragi Pref. (茨城県を中心に検討中)
Passengers Carried (輸送人員) (Person) (人)	Operation Completion Year (整備完了年次) Peak Hours (ピーク時)	1990: (昭65) 72,000/day 13,000/hour	1985: (昭60) 68,000/day 10,000/hour	1985: (昭60) 17,000/day 2,000/hour	1990: (昭65) 31,000/day 6,000/hour	1991: (昭66) 47,000/day 5,000/hour	1985: (昭60) 95,000/day -	- -
Construction Cost (建設費)	Disbursed by operator (事業者負担分)	230 hundred million yen (億円)	222 hundred million yen (億円)	20 hundred million yen (億円)	136 hundred million yen (億円)	31 hundred million yen (億円)	-	-
	Public Enterprises, etc. (公共事業等)	190	215	-	109	245 hundred (億円) million yen by National Railways (国鉄) 25 hundred million-yen munici- (億円) pality (自治体)	-	-
	Total (計)	420	437	20	245	301	-	-
	per kilometer (キロ当り)	61	68	4.8	32	23	-	-
Minimum Curve Radius in the Main Track (m) (本線最小曲線半径)		70	30	40	100	25	-	-
Maximum Grade in the Main Track (0/00) (本線最急勾配)		25	50	45	60	60 (down Grade) (下り) 55 (up ") (下り)	-	-
Turnout System (分岐方式)		Movable Guide plate system (可動轍叉方式)	Up and down system (昇降式)	Pin-joint system (ピンジョイント式)	Pin-joint system (ピンジョイント式)	Movable Guide plate system (可動轍叉方式)	-	-
Type of Electric Railway (電気鉄道の方式)		600 V, 3φA.C.	600 V, 3φ A.C.	750, D.C.	-	600 V, 3φ A.C.	-	-
Braking System (制御の方式)		ATO, ATC	ATO, ATC	ATS	ATO, ATC	ATC	-	-
Remarks (備 考)		Future Target: Unmanned Operation (将来は無人運転を目標)	Future Target: Unmanned Operation (同上)	One-man Operation is scheduled (ワンマン運転を予定)	Future Target: Unmanned Operations (将来は無人運転を目標)	One-man Operation is scheduled (ワンマン運転を予定)	One-man Operation is scheduled (同上)	-

12. Comparison of Shinkansen and French TGV
（新幹線とTGVの比較）

October 1981

Comparison Item（比較項目）	Japanese Shinkansen（新幹線）	French TGV（TGV）	Remarks（記事）
1. Transport volume（輸送量）			
(1) Transport volume per day（一日の輸送量）	About 340,000 persons (Maximum in the past: 1,030,000)（過去の最大）	About 9,000 persons	
(2) Transport volume per train（一列車の輸送量）	1,342 persons (First class: 132, Economy class: 1,210)（1等）（2等）	375 persons (First class: 135, Economy class: 240)（1等）（2等）	HIKARI: 1,342 persons KODAMA: 1,483 persons
(3) Number of trains per day（一日の列車本数）	255 trains	About 25 trains	
2. Transport efficiency（輸送の生産）			
(1) Energy consumption per passenger（乗客一人当りの消費エネルギー）	8.8kW	16.9kW	
(2) Car manufacturing cost per passenger（乗客一人当りの車両製造費）	¥ 2.38 million（百万円）	¥ 5.07 million（百万円）	
3. Passenger service（旅客サービス）			
(1) Car body cross section ratio（車体断面比）	1	0.7	○ Shinkansen cars are equipped with air cushions.（新幹線は空気バネ台車）
(2) Flexibility to number of passengers（座席対応）	Can exceed seating capacity（定員を越えても乗車可能）	Restricted to the seat limit.（定員しか乗車出来ない）	
(3) Seat interval（座席間隔）	98 cm	86 cm	○ Seat interval in the Jumbo planes are about 90 cm.（ジャンボ機は約90cm）
(4) Air sealing（耳ツン対策）	No discomfort to passengers' ears at tunnel entrance and exit.（トンネルの出入りでも乗客には何の支障もない）	Not structured with air sealing.（気密構造となっていない）	
4. Situation along the railroad（沿線の状況）			
(1) Topography（地形）	Mountains along the road.（起伏の多い山岳地帯）	Plain of gentle slopes.（なだらかな平原）	
(2) Population distribution（人口分布）	Densely populated area.（沿線は人口稠密である）	Mostly pastureland（牧草地が主体）	
5. Operating results of 17 years（17年間の実績）			
(1) No accident（17年間無事故輸送）	Number of transported passengers in 17 years: 1.7 billion（10億）（17年間の総輸送人員） Total kilometerags of operation in 17 years: 550,000,000 km（17年間の総走行距離） (Equivalent to 716 round-trips to the moon)（月まで716往復）		
(2) Experience and improvement（17年間の経験と改善）	Improvement of coaches and facilities Implementation of countermeasures against snow, rain and wind（車両設備の改善，雪，雨風の対策の実施）		

Organization of Ministry of Transport



APPENDIX D

1982 EDITION

FACTS & FIGURES

JAPANESE
NATIONAL
RAILWAYS

KEY STATISTICS, 1981

Railway Route Length (km)	21,419
Double- and Multi-tracked Sections	5,654
	(26.4%)
Electrified Sections	8,435*
	(39.4%)
Conventional Lines, Narrow Gauge (1,067 mm)	
D.C.	4,965
A.C.	3,470
Shinkansen, Standard Gauge (1,435 mm)	
A.C.	1,069
Railway Stations	5,305
Passenger and Freight	1,036
Passenger	4,149
Freight	111
Length of Bridges (km)	2,362
Length of Tunnels (km)	1,891
Train-km (thousands)	650,603
Railway Traffic Volume (millions)	
Passengers Carried	6,793
Tons Carried	111
Passenger-km	192,115
Ton-km	33,398
Number of Employees	401,362
Revenues & Expenses (million yen)	
Revenues	3,246,106
Expenses	4,331,997

* Excludes the Shinkansen lines.

CONTENTS

	Page
REVIEW OF THE YEAR	1
ORGANIZATION AND LEGAL STATUS OF JNR	1
Relationship with the Government	
Powers Delegated to and Restrictions Imposed on JNR	
TARIFF SYSTEM	1
Passenger Rates	
Freight Rates	
DOMESTIC TRAFFIC AND SHARES OF VARIOUS MODES OF TRANSPORT	2
PASSENGER SERVICE	2
Passenger Traffic	
Passenger Revenue	
Traffic in Metropolitan Areas	
Computerized Seat Reservation System	
FREIGHT SERVICE	4
Freight Traffic	
BUS SERVICE	5
FERRY SERVICE	5
SUBSIDIARY ENTERPRISES	5
ROLLING STOCK AND TRAIN OPERATION	6
Number of Locomotives and Cars	
Electrification and Dieselization	
Train Speeds	
Double tracking	
Number of Trains and Train-km per Day	
MAINTENANCE AND SAFETY	7
Rolling Stock, Track, Structures	
ATS, ATC, CTC	
Automatic Signals, Level Crossings	
Train Operation Accidents	
PERSONNEL	8
Number and Productivity of Employees	
Personnel Structures by Age and Service Year Groups	
Employees by Organization	
REVENUES AND EXPENSES	9
General Account	
Separate Account	
Separate Accounting by Groups of Lines	
Management Improvement Plan	
Major Results Under the Management Improvement Plan	

	Page
SHINKANSEN	13
Tokaido-Sanyo Shinkansen	
Tohoku Shinkansen	
Joetsu Shinkansen	
NATIONWIDE SHINKANSEN NETWORK	13
Seikan Undersea Tunnel between Honshu and Hokkaido, Suspension Road-Rail Bridges between Honshu and Shikoku	
TECHNOLOGICAL DEVELOPMENT	14
Operational Improvements	
Safety, Security and Reliability	
Maglev System	
ENVIRONMENTAL PROTECTION	15
ENERGY EFFICIENCY BY TRANSPORT MODE	15
INTERNATIONAL COOPERATION	15
Dispatch of JNR Experts	
Trainees and Visitors from Abroad	
Overseas Offices	
CHRONOLOGY	16
JNR Network	
JNR Organization Chart	

EXPLANATORY REMARKS

1. The years in this booklet are fiscal years ending on March 31 of the following calendar year.
   All the figures, unless otherwise stated, are as at the end of fiscal year 1981.
2. In quoting figures, decimal fractions of five and over are counted in most cases as a unit, and the rest are disregarded.
   The sum of figures in some cases thus may not coincide with the total given.
3. Conversion rates
   ¥1,000 = **US$3.70** (As of October 1, 1982)
   1 km = 0.621 mi
   1 kg = 2.205 lbs

REVIEW OF THE YEAR

JNR traffic in 1981 suffered from a near-stagnant economy. Japan's GNP grew by only 2.7%, the lowest since 1974. Most domestic transportation services experienced little or no growth; JNR passenger traffic recorded a slight decrease from the previous year, while rail freight traffic showed a second successive year of sharp decline.

Total domestic traffic by all modes registered 790,500 million passenger-km, up 1.1%, and 427,500 million ton-km, down 2.6%, compared with the previous year. JNR trains (excluding ferry boats and buses) accounted for 192,100 million passenger-km, a decrease of 0.5%, and 33,400 million ton-km, a 9.6% drop. The JNR rail market share was 24.3% of total domestic passenger traffic and 7.8% of freight traffic.

Operating revenues totaled 3,173,000 million yen, a gain of 209,300 million yen, or 7%, over the previous year. Passenger revenue rose because of tariff increases, aggressive promotion of rail travel, and increased subsidies. Freight revenue fell with the decline in freight traffic caused by slow business recovery and competition with other transportation systems.

Despite personnel reductions and other efforts to cut expenditures, operating expenses totaled 4,325,400 million yen, an increase of 361,200 million yen, or 9%, over the previous year. The change was mainly due to significant increases in payments to employees upon retirement, dues to the mutual aid pension fund, and interest on debt. The result was an operating loss of 1,152,400 million yen, and, after incorporating non-operating revenues and expenses, a net loss of 1,085,900 million yen.

ORGANIZATION AND LEGAL STATUS OF JNR

1. Relationship with the Government

The first railway in Japan was opened between Shimbashi (Tokyo) and Yokohama by the State in 1872. Since then the State Railways had grown as a system operated by a Governmental Department until 1949, when the present Japanese National Railways (JNR) was established as a public corporation under the Japanese National Railways Law. The National Government is the sole investor in JNR, which is operated under the supervision of the Ministry of Transport. The Ministry has a Transport Council that advises the Minister.

2. Powers Delegated to and Restrictions Imposed on JNR

The JNR President has full decision-making powers on some aspects of JNR management, while for others, the permission or authorization of the Minister of Transport is required. Basic passenger and carload freight rates can be revised within prescribed limits with the approval of the Minister of Transport; otherwise, approval of the National Diet is required. For revision of passenger and freight charges authorization of the Minister of Transport is sufficient. Some other important matters requiring approval of the Minister of Transport are:

(1) Construction of new railway lines and acquisition of private railways or other transportation operations.

(2) Operation of new ferry lines or new motor transport services related to JNR's railway service.

(3) Closure or suspension of service on a line.

(4) Major projects, such as electrification of railway lines, that are stipulated under Ministry of Transport Ordinances.

On minor operating matters, final decisions are made by the President, but on important matters, by the JNR Board; the President is the Chairman of this Board.

JNR is authorized to operate:

(1) The railway enterprise and related activities.

(2) Ferry services and related activities in connection with the railway enterprise.

(3) Motor transport services and related activities in connection with the railway enterprise.

(4) Pipelines whose pipes are primarily underneath land used for the railway enterprise, and related activities.

(5) Facilities for power generation and transmission and electric communication necessary for providing the above services.

(6) Other related necessary business activities.

JNR also may perform certain services for others if these services are related to land transport and do not interfere with normal operations: manufacture, repair, inspect or procure machines, tools and other commodities, carry out construction work, manage business activities, or conduct technical experiments and research.

JNR is required to have its activities inspected by the Inquiry & Audit Board, whose members are appointed by the Minister of Transport.

TARIFF SYSTEM

The Japanese National Railways Tariff Law amendment in December 1977 authorized JNR to determine its basic passenger and carload freight rates with only the approval of the Minister of Transport, provided that upward tariff revisions allowable will be limited to covering the increment in expenses caused by the rise in commodity prices. For revisions beyond this limitation, approval of the National Diet is required. This amended law became effective from March 31, 1978 and is to remain in force until the extinction of JNR's accumulated deficit, excluding the debt shelved.

1. Passenger Rates

The two-zone tapering-distance scale for ordinary fares was changed to three zones in May 1979. Rates per km were raised by an average of 5.5% in April 1980, 9.5% in April 1981, and again 6.7% in April 1982.

Ordinary Fare Rates per Kilometer

Zone / Effective	Up to 300 km	301–600 km	Over 600 km
May 1979	¥10.70	¥ 8.55	¥4.70
April 1980	11.35	9.05	4.95
April 1981	12.40	9.90	5.40
April 1982	13.25	10.55	5.75

Commutation pass rates vary with the type, validity period and traveling distance; in recent years discounts applying to commutation travel have gradually been reduced. JNR is authorized to set charges, such as those required for use of express trains, berths and "Green Cars" (cars with superior accommodations), with the approval of the Minister of Transport; these were not changed in 1979 but were raised in 1980 and 1981.

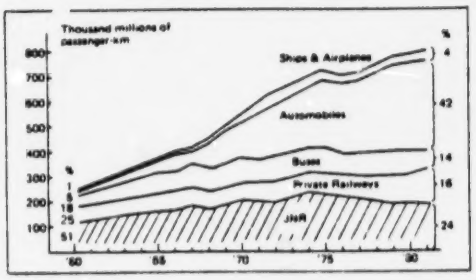
2. Freight Rates

Carload rates, previously divided into three classes by commodity, were combined into one class in April 1980. They are calculated by weight and distance of haul. Containerload rates are also based on weight and distance, but on a separate scale that is set by JNR with the approval of the Minister of Transport.

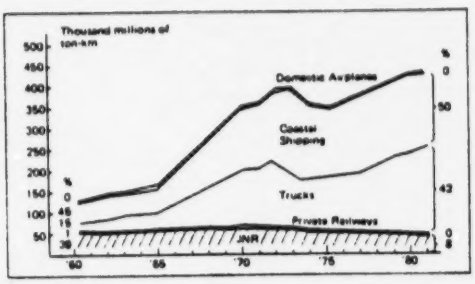
After national economic trends and competition from other modes were taken into account, carload rates were raised by 9.8% on the average in April 1980, and containerload rates by 6.7%. They were raised again by an average of 9.9% each in April 1981, and in April 1982 by 6.8% and 6.4% respectively.

DOMESTIC TRAFFIC AND SHARES OF VARIOUS MODES OF TRANSPORT

Shares of Various Modes of Transport in Passenger Traffic



Shares of Various Modes of Transport in Freight Traffic



PASSENGER SERVICE

1. Passenger Traffic

Domestic passenger traffic for fiscal year 1981 by all modes amounted to 790,500 million passenger-km, only 1.1% over the previous year, reflecting stagnant economic conditions and personal spending. Of this total, JNR carried ordinary passengers for 113,800 million passenger-km and commuters for 78,300 million passenger-km, totaling 192,100 million passenger-km.

Shinkansen traffic remained almost the same as in the previous year, with the help of promotional efforts to increase passenger revenue, especially from visitors to the Portopia exposition in Kobe.

Traffic by limited and ordinary express trains on the conventional lines declined 3.8% from the previous year, largely because of expansion of the express highway network and increases in jet aircraft flights to local airports. Lines in Hokkaido reported a small increase, however, when the Sekisho line was opened to provide more direct service to the Kushiro and Obihiro regions.

Electric train services in metropolitan areas showed an increase of 0.8% for ordinary passengers and 1.3% for commuters.

Passenger traffic on local lines — lines other than trunk lines, and outside of metropolitan areas — decreased 5.3% from the previous year. These lines account for 45% of JNR route length, but their 9,500 million passenger-km in 1981 was only 5% of the system total.

Passengers Carried

(millions)

Year	Ordinary		Commuter		Total	
1975	2,558	100	4,490	100	7,048	100
1977	2,509	98	4,560	102	7,068	100
1978	2,444	96	4,553	102	6,997	99
1979	2,392	94	4,539	101	6,931	98
1980	2,376	93	4,448	99	6,825	97
1981	2,348	92	4,445	99	6,793	96

Passenger-Kilometers

(millions)

Year	Shinkansen		Conventional lines				Total	
			Express train		Local train			
1975	53,318	100	52,990	100	108,981	100	215,289	100
1977	42,187	79	46,655	88	110,810	102	199,653	93
1978	41,074	77	44,244	83	110,526	101	195,844	91
1979	40,986	77	43,301	82	110,403	101	194,690	90
1980	41,790	78	42,407	80	108,947	100	193,143	90
1981	41,717	78	40,784	77	109,614	101	192,115	89

Note: "Express train" includes both limited express and ordinary express trains.

2. Passenger Revenue

JNR passenger revenue amounted to 2,309 thousand million yen, an increase of 7.7% over the previous year. This reflects the April 1981 increase in passenger rates and JNR efforts to increase revenue through sales campaigns and promotional fares, such as the Full Moon Pass for older couples and the Japan Rail Pass for foreign tourists.

Passenger Revenue

(thousand millions of yen)

Year	Ordinary passengers		Commuters	Total	
	Shinkansen	Conventional lines			
1975	473	608	148	1,081	100
1977	610	873	240	1,723	160
1978	646	939	264	1,849	171
1979	692	1,043	320	2,055	190
1980	722	1,069	352	2,143	198
1981	781	1,139	389	2,309	214

Average Traveling Distance per Passenger

(km)

Year	Ordinary		Commuter		All passenger average		Shinkansen	
1975	54.5	100	16.9	100	30.6	100	339	100
1977	48.6	89	17.1	101	28.2	92	333	98
1978	48.1	88	17.2	102	28.0	92	332	98
1979	48.4	89	17.4	103	28.1	92	331	98
1980	48.5	89	17.5	104	28.3	93	333	98
1981	48.5	89	17.6	104	28.3	92	332	98

3. Traffic in Metropolitan Areas

The number of passengers carried by JNR in the Tokyo metropolitan area increased slightly in 1981, after several years of small declines; private railway and subway traffic continued to increase. In the Osaka metropolitan area, both JNR and private railways continued to show reductions in the number of passengers carried, while the subway system again showed an increase. The JNR share of the total number of railway passengers in 1981 was 40% in Tokyo and 22% in Osaka.

As a general tendency, metropolitan area traffic rises to show peaks during office and school commuter hours, causing severe congestion. This congestion was eased to some extent on Tokyo's Sobu line and in other places through improvements to increase capacity. In Osaka, the congestion rate showed a declining tendency on most lines, accompanying the traffic decrease; the Katamachi line was an exception to this trend.

Railway Passenger Traffic in the Tokyo Metropolitan Area

(Daily average in thousands)

Year	JNR		Private railways		Subways		Total	
1975	10,343	100	9,230	100	4,789	100	24,362	100
1977	10,577	102	9,546	103	5,030	105	25,153	103
1978	10,577	102	9,756	106	5,039	105	25,372	104
1979	10,527	102	9,822	106	5,086	106	25,435	104
1980	10,379	100	10,000	108	5,487	115	25,866	106
1981	10,424	101	10,163	110	5,625	117	26,212	108

Railway Passenger Traffic in the Osaka Metropolitan Area

(Daily average in thousands)

Year	JNR		Private railways		Subways		Total	
1975	2,458	100	6,488	100	2,074	100	11,020	100
1977	2,481	101	6,403	97	2,047	97	10,931	99
1978	2,446	100	6,445	99	2,084	100	10,975	100
1979	2,391	97	6,287	97	2,095	101	10,773	98
1980	2,303	94	6,069	94	2,184	105	10,555	96
1981	2,282	93	6,042	93	2,262	109	10,586	96

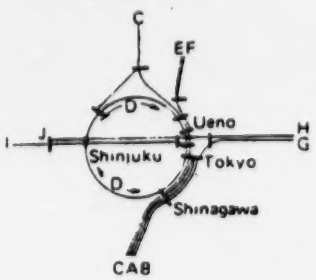
Notes: 1. The figures for each mode of transport indicate ordinary ticket and commutation pass users combined.
2. Tokyo and Osaka metropolitan areas refer to an area 50 km in radius from Tokyo Station and Osaka Station respectively.

Train Operation during Rush Hours in the Tokyo Metropolitan Area

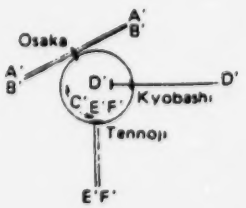
(As of November 1981)

Route	Line	Train consist (cars)	Load factor (%)	Headway
A	Tokaido	15	225	3'30"
B	Yokosuka	15	223	5'30"
C	Keihin Tohoku	10	252	2'30"
D	Yamanote	10	233	2'30"
E	Joban (Rapid service)	10	274	6'00"
F	Joban (Local service)	10	247	3'20"
G	Sobu (Rapid service)	15	231	4'00"
H	Sobu (Local service)	10	244	2'40"
I	Chuo (Rapid service)	10	258	2'10"
J	Chuo (Local service)	10	185	3'00"

Tokyo Metropolitan Area



Osaka Metropolitan Area



Train Operation during Rush Hours in the Osaka Metropolitan Area

(As of November 1981)

Route	Line	Train consist (cars)	Load factor (%)	Headway
A'	Tokaido (Rapid service)	11–12	208	7'30"
B'	Tokaido (Local service)	7	209	4'20"
C'	Osaka Loop	8	228	3'00"
D'	Katamachi	6	252	4'00"
E'	Hanwa (Rapid service)	6	251	5'00"
F'	Hanwa (Local service)	6	201	5'00"

3. Computerized Seat Reservation System

For better service to travelers, MARS 202 was introduced to deal exclusively with party and group travelers, supplementing MARS 105 that had been at work since September 7, 1972 for individual reservations.

Central processing unit	No. of Green Windows	No. of omputer terminals at ticket windows	No. of superior trains covered by computer (per day)	No. of seats covered by computer (per day)
MARS 105	781	1,590	1,675	498,460
MARS 202	–	159	2,037	456,755

FREIGHT SERVICE

1. Freight Traffic

JNR freight traffic in 1981 totaled 33.4 thousand million ton-km, a decline of 9.6% from the previous year. Tons carried, 110.57 million, were down 9.1% from the previous year and 21% below the level in 1979. This significant decrease is due largely to stagnant manufacturing activity, cold weather damage to crops and intensified competition from other modes of transport. Revenue from freight traffic decreased by 5.6% from 1980 and by 12.1% from 1979.

Freight Traffic

Year	Tons carried		Ton-kilometers		Daily average ton-km (millions)	Revenue (thousand million yen)
	(millions)	Index	(thousand millions)	Index		
1975	142	100	46.6	100	141	231.9
1977	132	93	40.6	87	127	295.6
1978	133	94	40.4	87	125	297.7
1979	136	96	42.3	91	116	340.9
1980	122	86	37.0	79	101	317.6
1981	111	78	33.4	72	92	299.8

(1) Principal commodities

The top four commodities, oil, limestone, cement and coal, accounted for 49.24 million tons carried, a decline of 6.6% from the previous year. Other noncontainerized commodities totaled 52.09 million tons, showing a large decrease of 11.6%.

Tonnage Carried by Commodity

(thousands)

Commodity	1980	1981
Oil	16,500	15,055
Limestone	15,343	14,598
Cement	14,986	13,823
Coal	5,891	5,763
Total (A)	52,720	49,239
Chemical fertilizer	5,367	4,517
Chemicals	3,655	3,430
Ore	3,913	3,256
Paper	3,194	2,947
Rice	2,999	2,770
Feed	2,873	2,275
Pig iron & steel	2,368	1,963
Alcoholic beverages	1,509	1,393
Timber & lumber	1,598	1,103
Motor vehicles	749	676
Pulp	697	619
Gravel & sand	478	336
Fresh fruits	322	240
Fresh & frozen fish	196	174
Other commodities	29,026	26,390
Total (B)	58,944	52,089
(A) + (B)	111,664	101,328
Containerized cargo	9,955	9,244
Total, all freight	121,619	110,572

(2) Containerized Freight

Container traffic decreased by 7% to 9,244 thousand tons and 5% to 7,788 million ton-km compared with the previous year. The decrease in short distance traffic was greater than that in middle and long distance movements, and the decreases in housing materials, chemical products and paper products were particularly notable. As in the case of other freight traffic, these declines were largely due to weakness in industrial activity and competition from other modes, such as trucks.

Container Traffic

Year	Tons carried (thousands)	Ton-kilometers (millions)
1975	12,114	9,378
1977	10,017	8,035
1978	10,286	8,387
1979	11,487	9,325
1980	9,955	8,197
1981	9,244	7,788

BUS SERVICE

The JNR total bus traffic in 1981 amounted to 2,486 million passenger-km, declining slightly by 0.6% from the previous year. This total includes an increase of 7.1% on expressway services, which gained from traffic to the Kobe Portopia exposition.

Bus service re-routing and rescheduling, including the closure of 12 routes (145 km) with low traffic density, permitted a reduction of 1.23 million vehicle-km from the previous year. Extra trips increased by 0.77 million vehicle-km, so that the net reduction was 0.46 million vehicle-km.

Bus Service Performance

Year	Revenue (thousand millions of yen)	Passengers carried (thousands)					Passenger-km (millions)
		All routes incl express ways	Tokyo–Nagoya Express way	Nagoya–Osaka Express way	Osaka–Ochiai Express way	Total for express ways	All routes incl express ways
1975	30.7	247 682	2.237	438	125	2.800	2.899
1977	36.4	227 896	2 568	397	372	3 337	2 786
1978	38.5	217 138	2 311	366	435	3.112	2 627
1979	39.0	212 035	2 089	363	489	2 941	2 562
1980	40.9	207 375	2 042	334	524	2.900	2.501
1981	42.8	202.246	2.134	360	522	3.016	2 486

Note The revenue includes non operating revenue

FERRY SERVICE

Of the four JNR ferry routes, the Seikan (Aomori-Hakodate) and the Uko (Uno-Takamatsu) routes are the important ones linking trunk rail lines. These two routes carry freight cars as well as passengers. The Miyajima route also continues in service but the Nikata-Horie route was closed in early 1982.

Passengers carried on all four routes numbered 9,850 thousand, a decrease of 3% from the year before. The number of passengers on the Seikan decreased by 9%, and the Uko 6%.

Tons of freight carried on the Seikan and Uko routes decreased by 6% and 10%, respectively, over the previous year.

Ferry Service Performance

Year	Revenue (thousand millions of yen)	Vessel kilometers (thousands)	Traffic volume		Number of vessels	Gross tonnage of vessels
			Pagrs (thousands)	Frt tons (thousands)		
1975	43.9	2.702	15.245	8.895	34	75.504
1977	16.1	2.644	10.968	7.281	32	76.621
1978	16.8	2.564	10.417	7.370	28	76.999
1979	18.9	2.571	10.169	8.063	29	77.028
1980	18.4	2.421	10.160	6.987	29	77.028
1981	18.2	2.334	9.854	6.431	29	77.884

Note The revenue includes non operating revenue

SUBSIDIARY ENTERPRISES

Revenue from JNR subsidiary enterprises maintained the annual growth rate of over 10 per cent that has been typical since 1975. Successful efforts to develop new services and some increases in rentals and other charges have made this growth possible despite the current sluggish economy and intensive competition.

Total revenue from these enterprises amounted to 63,500 million yen in 1981; the rate of increase, 12 per cent, was the largest since 1977. Rentals and commissions on services for passengers accounted for about 50 per cent of total revenue, and part of the increase in this category came from a 20 per cent growth in income from station buildings and station department stores. This growth was primarily the result of the construction and opening of 10 new station buildings.

By the end of 1981, JNR had invested a total sum of 26,100 million yen in 103 subsidiary enterprises. Of these 103, 81 were already in business and 62 of them showed profits in 1981.

Effective October 26, 1982, JNR was authorized to invest in enterprises that will handle transactions involving housing and office buildings on JNR property, in addition to the kinds of enterprises previously authorized such as port and harbor railways, freight terminals, passenger terminal facilities such as station buildings and hotels, advertising companies and ticket sales agencies.

Revenue from Subsidiary Enterprises

(thousand millions of yen)

Year	Total revenue from subsidiary enterprises	Index
1975	32.8	100
1977	43.0	131
1978	47.0	143
1979	51.1	156
1980	56.7	173
1981	63.5	193

(millions of yen)

	1980	1981	Ratio %
Rentals and commissions on services for passengers	28,081	31,764	113
Charges for advertising	14,122	15,848	112
Rental of land	9,907	10,835	109
Rental of parking areas	3,698	4,045	109
Rentals and commissions on services for freight customers	560	585	104
Dividends	176	248	141
Other revenue	128	126	98
Total	56,671	63,451	112

ROLLING STOCK AND TRAIN OPERATION

1. Number of Locomotives and Cars

More electric railcars have enabled JNR to increase train speed and improve its service.

Locomotives and Cars

Year	Passenger cars	Freight cars	Electric railcars	Diesel railcars	Steam locos	Electric locos	Diesel locos
1975	6,725	120,597	16,502	5,326	15	2,051	2,204
1977	6,751	109,890	16,843	5,310	15	2,049	2,207
1978	6,567	101,042	17,247	5,233	5	1,978	2,160
1979	6,532	99,846	17,462	5,225	5	1,936	2,125
1980	6,176	99,562	17,696	5,038	5	1,856	2,109
1981	6,070	98,001	18,144	4,948	5	1,760	2,075

Note: Privately-owned cars are not included.

(1) Number of Electric Railcars

There has been a remarkable increase in electric railcars in recent years, as is seen in the following table.

Electric Railcars

Year	For Shinkansen trains	For limited express trains	For ordinary express and suburban trains	For commuter trains	For other trains
1975	2,245	2,240	6,462	5,298	267
1977	2,354	2,297	6,599	5,325	268
1978	2,358	2,602	6,724	5,293	270
1979	2,372	2,635	6,935	5,276	290
1980	2,415	2,735	6,890	5,383	273
1981	2,646	2,899	7,213	5,214	172

(2) Number and Kinds of Freight Cars

Box cars	60,134
Refrigerator cars	1,614
Ventilated cars	74
Tank cars	16
Gondola cars	19,035
Flat cars	1,619
Container cars	6,626
Hopper cars	4,942
Others	3,941
Total	98,001

2. Electrification and Dieselization

As of March 1982, 39.4% or 8,435 km of the total route length was electrified. The JNR Motive Power Modernization Program was completed with the last steam locomotive withdrawn from service in March 1976. To meet popular demand, however, two steam locomotives, one each from the C57 and C58 classes, were restored to seasonal passenger service in August 1979 on the Yamaguchi Line.

Year	Route length AC/DC electrified (km)	Percentage of total route length
1975	7,628 (3,036)	35.9
1977	7,813 (3,210)	36.7
1978	8,032 (3,214)	37.7
1979	8,279 (3,335)	38.8
1980	8,414 (3,470)	39.5
1981	8,435 (3,470)	39.4

Notes: 1. The figures in parentheses indicate the route length AC electrified.
2. Route length electrified does not include the Shinkansen lines.

Train-kilometers by Type of Traction

(Daily average in thousands) (As of April 1982)

Passenger trains	Electric loco	Electric railcar	Diesel loco and railcar
	118.3	887.0	402.5
	(8.4%)	(63.0%)	(28.6%)

Freight trains	Electric loco	Diesel loco
	311.0	95.6
	(76.5%)	(23.5%)

3. Train Speeds

Scheduled speeds for various kinds of trains are shown below.

(As of November 1982)

Kinds of trains		Scheduled speeds (km/h)
Passenger trains		
Locomotive-hauled trains	Limited express	65.5
	Ordinary express	52.8
	Local	35.6
Electric multiple unit trains	Shinkansen	
	Hikari	150.4
	Kodama	123.2
	Limited express	69.3
	Ordinary express	58.7
	Local	44.0
Diesel multiple unit trains	Limited express	61.3
	Ordinary express	51.6
	Local	35.1
Freight trains		
Limited express		60.3
Ordinary express		41.2
Others		25.5

Note: Scheduled speed = $\frac{\text{Distance between origin and destination stations}}{\text{Total time required including stopping time}}$

Speeds of Typical Fast Trains

(As of November 1982)

	Shin-kansen train	Electric multiple unit train	Diesel multiple unit train	High speed freight train
Operating section	Tokyo–Hakata	Maibara–Kanazawa	Hakodate–Abashiri	Tokyo–Osaka
Distance (km)	1,069	177	661	561
Scheduled speed (km/h)	160	85	64	70
Maximum speed (km/h)	210	120	100	95

4. Double-tracking

JNR has been placing high priority on double-tracking of its important trunk lines and, as of March 1982, double- and multi-tracked sections accounted for 26% or 5,654 km of its total route length.

Year	Double- and multi-tracked sections	
	Kilometers	Percentage
1975	5,424	26
1977	5,479	26
1978	5,530	26
1979	5,604	26
1980	5,641	27
1981	5,654	26

Note: Excludes the Shinkansen lines.

5. Number of Trains and Train-km per Day

(As of April 1982)

		Number of trains	Train-km (thousands)
Conventional Lines	Passenger trains	20,703	1,218
	Limited express	650	208
	Ordinary express	817	162
	Local	16,886	815
	Deadhead	2,350	33
	Express & baggage trains	143	41
	Mixed trains	31	2
	Freight trains	3,721	366
	Limited express	80	65
	Ordinary express	65	33
	Local	3,576	268
	Other trains*	2,349	5
	Sub-total	26,947	1,632
Shin-kansen	Hikari	138	99
	Kodama	117	47
	Deadhead	277	6
	Sub-total	532	152
	Total	27,479	1,784

* Includes service trains & light engines.

MAINTENANCE AND SAFETY

1. Rolling Stock

Major repairs of rolling stock are done at 20 workshops in key locations throughout the country, and minor routine repairs and inspections are made at various depots. The repair and inspection work is now simplified through mechanization and automation and the intervals between inspections have been lengthened.

KICS (Kosaku Information Control System), which uses computers for modern management and operations at workshops, is proving quite effective in raising efficiency.

2. Track

Labor saving and mechanization of inspection are emphasized in the modernization of track maintenance work. Maintenance-free slab track, heavier rails and PC sleepers as well as machinery are used to reduce maintenance labor. High-speed track measuring cars are operated on the Shinkansen once every seven days, and on the conventional lines two to six times a year depending upon the need.

3. Structures

Maintenance standards have been established for bridges and tunnels, and repair and replacement work is carried out as necessary to keep these structures in good condition.

4. ATS

All JNR trains and lines have been equipped with an Automatic Train Stop system since 1966, and this has eliminated accidents from violation of signals.

5. ATC

Automatic Train Control systems are in use on the Shinkansen and several Tokyo subway lines. The entire Yamanote line in Tokyo was put under ATC in December 1981 for safer and more efficient commuter service, and wider use of ATC is planned.

6. CTC

In 1981, Centralized Traffic Control was installed on another 529 km, bringing the lines under CTC up to 6,144 km, or 29% of the total route length.

Year	Lines under CTC (km)	Percentage of total route length
1975	3,897	18
1977	4,878	23
1978	5,238	25
1979	5,463	26
1980	5,615	26
1981	6,144	29

Note: Excludes the Shinkansen lines.

7. Automatic Signals

Automatic signals were installed on 363 km of lines in 1981, raising the percentage of lines with such signals to 53% of the total route length.

Year	Single track (km)	Double track (km)	Total (km)	Percentage of total route length
1975	4,585	5,472	10,057	47
1977	5,105	5,527	10,632	50
1978	5,273	5,572	10,845	51
1979	5,391	5,598	10,989	52
1980	5,421	5,638	11,059	52
1981	5,758	5,664	11,422	53

Note: Excludes the Shinkansen lines.

8. Level Crossings

Work continued on measures to reduce accidents at level crossings. Some level crossings were eliminated by relocating of railway track to elevated viaducts and construction of overpasses and underpasses; automatic barriers or warning signals were installed at others; and some crossings were closed.

Description	1975	1981
With barriers (manually, automatically or semi-automatically operated)	13,466	18,277
With warning signal device	5,132	3,473
Unprotected	12,566	7,935
Total	31,164	29,685

Note: Distance between level crossings averages 714 meters.

9. Train Operation Accidents

Accidents at level crossings are JNR's most serious safety problem. In spite of the increasing number of motor vehicles, however, these accidents are on the decrease.

Year	Train accidents	Level crossing accidents	Other accidents
1975	59 (0.09)	1,288 (2.05)	4
1977	41 (0.06)	1,077 (1.69)	0
1978	51 (0.08)	945 (1.39)	1
1979	61 (0.09)	839 (1.35)	0
1980	51 (0.08)	846 (1.40)	0
1981	33 (0.05)	771 (1.30)	2

Notes: 1. The figures in parentheses indicate the number of accidents per million train-km.
2. One accident giving rise to another is counted as two accidents.

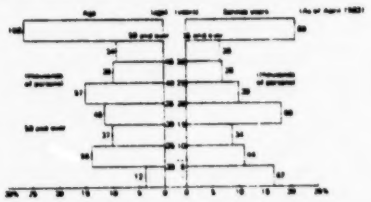
PERSONNEL

1. Number and Productivity of Employees

JNR continued to implement its policy of saving labor through modernization of motive power, improvement of working methods and mechanization of facilities.

Year	Number of employees	Pagr-ton-km per employee (thousands)	Index	Monthly average basic pay including family and area allowances (thousands of yen)	Index
1975	430,051	619	100	107	100
1977	428,928	569	91	157	147
1978	426,697	562	91	190	176
1979	420,815	572	92	197	184
1980	413,594	557	90	205	192
1981	401,362	561	91	215	201

2. Personnel Structures by Age and Service Year Groups



3. Employees by Organization

(As of April 1982)

	Number of employees
Railway Operating Divisions	20,767
Training Schools	1,416
Workshops	24,495
Hospitals and Clinics	3,385
Stations	110,418
Conductors' Depots	27,231
Engine Depots	47,947
Electric Railcar Depots	13,454
Car Operating & Repair Depots	23,275
Passenger & Freight Car Depots	12,570
Maintenance of Way Depots	40,067
Electric Power Depots	8,510
Signal & Telecommunication Maintenance Depots	10,010
Others*	57,817
Total	401,362

* Includes the Head Office, its auxiliary organizations, and the Shinkansen Administration.

REVENUES AND EXPENSES

1. General Account

The General Account shows operation revenues of 3,173,000 million yen and operating expenses of 4,325,400 million yen, resulting in an operating loss of 1,152,400 million yen. Adding the non-operating revenues to this amount and deducting the non-operating expenses yields a net loss of 1,085,900 million yen. The breakdown of this net loss into the specific retirement allowance loss of 263,800 million yen and the general net loss of 822,100 million yen shows that the general net loss decreased by 7,900 million yen (1%) from the previous year.

(1) Operating Revenues

Operating revenues amounted to 3,173,000 million yen, which was an increase of 209,300 million yen, or 7%, over the previous year. Three major factors led to this improvement: a system-wide increase in passenger fares and charges, aggressive promotion of rail travel, and increases in subsidies. Out of the operating revenues, passenger revenue accounted for 2,403,500 million yen, an increase of 161,000 million yen (7%), while freight revenue was 311,400 million yen, a decrease of 18,200 million yen (6%). Miscellaneous revenue amounted to 115,400 million yen, up 12,800 million yen (13%); of this, revenue from subsidiary enterprises totaled 63,500 million yen, up 6,800 million yen (12%). Subsidies for specific retirement allowances and construction expenses were increased, and total subsidies received amounted to 342,800 million yen, an increase of 53,700 million yen (19%).

(2) Operating Expenses

Operating expenses totaled 4,325,400 million yen, showing an increase of 361,200 million yen, or 9%, over the previous year. This was despite the efforts exerted to reduce operating expenditures through greater efficiency. Factors causing the increase included an increased number of personnel retiring during the year, increased provision for pensions through the mutual aid association, higher wage payments in accordance with arbitration, larger interest payments on long-term debts, and greater bond handling expense. Of the operating expenses, personnel expense was 2,007,200 million yen, up 148,500 million yen (8%); material expense, including taxes & other public payments, 1,296,500 million yen, up 65,200 million yen (5%); and capital expense (interest, bond handling expense and depreciation) 1,021,800 million yen, up 147,600 million yen (17%). Personnel, material and capital expenses accounted for 46%, 30% and 24%, respectively, of the operating expenses.

Revenues & Expenses of General Account

(thousand millions of yen)

Classification \ Year	1976	1977	1978	1979	1980	1981
Operating revenues	1,993.1	2,389.0	2,670.2	2,902.1	2,963.7	3,173.0
Passenger	1,515.1	1,889.0	1,948.9	2,155.0	2,242.4	2,403.5
Freight	277.9	307.0	309.5	363.9	329.6	311.4
Miscellaneous	71.4	79.7	88.8	94.8	102.5	115.4
Financial rehabilitation subsidies	114.8	158.6	221.9	288.4	289.1	342.8
Operating expenses	2,915.8	3,214.7	3,471.4	3,744.8	3,964.3	4,325.4
Personnel	1,398.8	1,530.2	1,656.7	1,730.3	1,858.7	2,007.2
Material	875.8	939.0	989.0	1,080.7	1,201.4	1,263.9
Taxes & other public payments	21.8	23.7	25.5	27.3	29.9	32.6
Interest & bond handling expenses	316.0	401.9	477.7	552.5	676.4	803.0
Depreciation	306.3	319.8	342.5	373.8	397.8	418.8
Operating profit or loss	−922.5	−846.7	−901.2	−842.5	−1,000.6	−1,152.4
Non-operating revenues	12.1	15.6	18.6	23.9	35.9	73.1
Non-operating expenses	3.7	3.9	4.2	3.2	43.7	6.8
Net profit or loss	−914.1	−833.9	−886.7	−821.8	−1,008.4	−1,086.9
General net loss	–	–	−809.9	−728.2	−830.0	−822.1
Specific retirement allowance net loss	–	–	−76.8	−93.6	−178.4	−263.8

Note: In 1976 a Separate Account for Specified Government Loans was established; this is separate from the General Account.

Balance Sheet of General Account

(thousand millions of yen)

Classification \ Year	1976	1977	1978	1979	1980	1981
Assets	7,338.5	8,907.4	10,681.4	12,528.9	11,100.3	13,086.7
Fixed assets	5,715.5	6,309.6	7,148.9	8,006.7	8,875.4	9,744.4
Investments	101.4	103.2	107.1	111.2	114.9	119.6
Working assets	48.9	51.7	47.3	53.4	53.1	54.4
Current assets	309.6	452.6	498.7	683.4	683.2	696.0
Deferred assets and others	188.6	182.2	183.5	188.5	184.8	207.4
Deficit carried over	974.2	1,808.2	2,884.9	3,516.7	1,178.8	2,264.7
Liabilities & Equity	7,338.5	8,907.4	10,681.4	12,528.9	11,100.3	13,086.7
Long-term liabilities	5,458.2	6,986.6	8,461.9	10,149.2	9,077.0	10,829.4
Short term liabilities	455.7	517.1	602.0	606.4	611.1	693.3
Other liabilities	107.0	142.0	255.8	412.5	574.7	726.8
Capital	456.0	456.0	456.0	456.0	456.0	456.0
Capital reserves	859.6	905.7	905.7	905.7	381.5	381.5

Note: In 1976 a Separate Account for Specified Government Loans was established; this is separate from the General Account.

2. Separate Account

A Separate Account was established in 1976 for specified government loans excluded from the General Account. This account continues to be excluded from the General Account as the Separate Account for Specified Government Loans, in accordance with the Japanese National Railways Management Rehabilitation Promotion Special Act of 1980.

Balance Sheet of the Separate Account for Specified Government Loans

(thousand millions of yen)

	1976	1977	1978	1979	1980	1981
Assets						
Specified deficit carried forward	2,540.4	2,540.4	2,540.4	2,540.1	5,322.1	5,322.1
Liabilities						
Long-term liabilities	2,540.4	2,540.4	2,540.4	2,540.1	5,322.1	5,322.1
Specified long-term loans	2,481.3	2,417.9	2,349.7	2,278.5	5,059.9	5,059.9
Loans for financial rehabilitation	59.1	122.5	190.7	263.6	262.2	262.2

Receipts and Disbursements of the Separate Account for Specified Government Loans

(thousand millions of yen)

	1976	1977	1978	1979	1980	1981
Receipts	185.0	180.6	175.9	171.2	386.4	345.7
Interest subsidy on loans for financial rehabilitation	185.0	180.6	175.9	170.9	345.7	345.7
Received from the General Account	–	–	–	0.3	40.7	–
Disbursements						
Interest on specified long-term loans	185.0	180.6	175.9	170.9	346.4	345.7
Appropriation for specified deficit carried forward	–	–	–	0.3	40.0	–

3. Separate Accounting by Groups of Lines

Under separate accounting by groups of lines, trunk lines registered a net loss of 700,500 million yen and local lines a loss of 347,300 million yen. Buses showed a 38,100 million yen loss.

The local lines as a group accounted for 10,800 million passenger-ton-km, only 5% of the total traffic. The loss sustained, however, represented 32% of the total net loss.

Profit and Loss Account of Trunk Lines and Local Lines for Fiscal 1981

Item \ Classification		Trunk lines (including commuter lines in metropolitan areas)	Local lines	Buses	Total
Route-km		12,644.7 (55.4%)	10,174.3 (44.6%)	14,052.6	36,871.6
Traffic volume	Passenger-km (thousand millions)	183.0 (95.1%)	9.5 (4.9%)	2.5	195.0
	Ton-km (thousand millions)	32.7 (96.3%)	1.3 (3.7%)	0	34.0
Revenues (thousand millions of yen)					
Passenger		2,269.8	94.7	38.7	2,403.4
Freight		293.1	17.5	0.8	311.4
Miscellaneous		110.3	4.6	0.6	115.4
Subsidies		212.5	128.2	2.1	342.8
Total		2,885.7 (92.2%)	245.1 (7.8%)	42.2	3,173.0
Expenses (thousand millions of yen)					
Operating		2,735.1	497.4	71.2	3,303.7
Capital		912.0	100.3	9.4	1,021.7
Total		3,647.1 (85.9%)	597.7 (14.1%)	80.6	4,325.4
Operating profit or loss (thousand millions of yen)		−761.4	−352.6	−38.4	−1,152.4
Non-operating profit or loss (thousand millions of yen)		60.9	5.3	0.3	66.5
Net profit or loss (thousand millions of yen)		−700.5 (64.5%)	−347.3 (32%)	−38.1 (3.5%)	−1,085.9 (100%)
	General net loss	−486.4	−303.6	−32.1	−822.1
	Specific retirement allowance net loss	−214.1	−43.7	−6.0	−263.8

4. Management Improvement Plan

Following the passage of the Law Providing Special Measures for Promotion of JNR Rehabilitation on December 27, 1980, JNR submitted its Management Improvement Plan, which was approved by the Minister of Transport on May 21, 1981. This thorough, comprehensive plan should restore JNR financial stability through the changes and improvements outlined below:

(1) Priorities, Rationalization and Efficiency

The transportation services to be emphasized are those that make the best use of the inherent characteristics of railways – intercity passenger transport, commuter traffic in metropolitan areas, large-volume freight movement, and freight transporation over fixed routes on regular schedules.

Service patterns are to be changed where traffic volume on local railway lines is too light for efficient railway operation.

Overall work efficiency, as measured by transportation service performed per employee, is to be raised; goals are a 25% increase in efficiency and a reduction to a staff of 350,000 by 1985.

(2) Revenues

JNR's spirit of enterprise and competition will be strengthened, to increase traffic and revenues where the JNR share of traffic has fallen behind other transport modes.

Tariff revision will be made in appropriate ways and at proper times, while maintaining a fair and just tariff structure.

Efforts will be made to increase revenues from JNR's subsidiary enterprises, which should contribute about ¥500,000 million from the start of the plan through 1985; some properties will be disposed of, and this would yield about the same amount.

(3) Investment

Because high capital costs have adversely affected recent financial results, investment in facilities is to be kept to a minimum; the investment scale during the plan period is to remain at the present level.

(4) Industrial Relations

Every effort will be made to improve labor-management relations and to maintain working standards, as these are essential to accomplish the objectives of the plan.

(5) Targets

The financial targets of this plan are to increase the general operating profit as much as possible and to reach the break-even point on trunk lines by 1985, in order to establish a sound financial basis for management.

From 1986, efforts will be made to bring the entire system to the break-even point as quickly as possible.

Revenues and Expenses

(thousand millions of yen)

Classification		1980	1985
Trunk lines	Operating revenues	2,607.7	3,850.0
	Operating expenses	2,784.4	3,360.0
	Operating profit or loss	-176.7	490.0
	Non-operating profit or loss	-271.6	-480.0
	Net profit or loss	-448.3	10.0
Local lines and buses	Operating revenues	125.0	180.0
	Operating expenses	475.3	400.0
	Operating profit or loss	-350.3	-220.0
	Non-operating profit or loss	83.8	-10.0
	Net profit or loss	-266.5	-230.0
Specific personnel expenses	Specific retirement allowances	-158.4	-260.0
	Specific pensions	-154.4	-310.0
	Non-operating loss (interest)	-11.3	-200.0
	Total	-324.1	-770.0
Total revenues and expenses	Operating revenues	2,732.7	4,030.0
	Operating expenses	3,572.5	4,330.0
	Operating profit or loss	-839.8	-300.0
	Non-operating profit or loss	-199.1	-690.0
	Net profit or loss	-1,038.9	-990.0
General operating profit or loss (trunk and local lines and buses)		-527.0	270.0

Notes 1 Capital expenses of 400,000 million yen for the Tohoku and Joetsu Shinkansen lines are not included.

2 Figures for fiscal 1980 are based on the supplementary budget.

Traffic Volume

(thousand millions)

Item		1980	1981	1982	1983	1984	1985
Passenger-km	Train	193.7	193.8	196.8	198.6	201.2	203.2
	Ferry	0.4	0.4	0.4	0.4	0.4	0.4
	Bus	2.5	2.5	2.5	2.5	2.5	2.5
	Total	196.6	196.7	199.7	201.5	204.1	206.1
Ton-km	Train	39.4	41.5	41.6	41.7	41.8	41.9
	Ferry	0.7	0.7	0.7	0.7	0.7	0.7
	Total	40.1	42.2	42.3	42.4	42.3	42.6
Passenger-ton-km	Train	233.1	235.3	238.4	240.3	242.8	245.1
	Ferry	1.1	1.1	1.1	1.1	1.1	1.1
	Bus	2.5	2.5	2.5	2.5	2.5	2.5
	Total	236.7	238.9	242.0	243.9	246.4	248.7

Note Figures for 1980 are based on the budget

Transport Capacity

(thousands)

Item			1980	1985
Passenger train-km/day	Shinkansen		178	230
	Conventional lines	Limited and ordinary expresses	414	310
		Other trains	845	850
	Total		1,437	1,390
Freight train-km/day			470	400
Baggage car-km/day			407	360
Ferry-km			2,483	2,290
Bus km			118,000	110,000

Employees and Productivity

Item \ Fiscal year	1979	1980	1981	1982	1983	1984	1985	Total change
Employees at start of year	424,000	419,500	408,500	396,500	382,200	366,700	350,000	-
Increase during year	4,400	8,400	2,000	2,300	2,600	1,300	-	20,900
Decrease during year	-8,900	-19,400	-14,000	-16,600	-18,100	-17,900	-	-94,900
Net change	-4,500	-11,000	-12,000	-14,300	-15,500	-16,700	-	-74,000
Traffic volume per employee, thousand passen ger-ton-km	-	564	585	610	640	670	710	-
General personnel expense as per cent of operating revenue	-	74	68	64	60	55	51	-
Operating revenue per employee, thousand yen	-	6,514	-	-	-	-	11,500	-

Personnel Reduction

Measure	Staff reduction
Modernization of work methods (More efficient use of train crews, fewer trains, fewer administrative personnel)	19,500
Investments to improve personnel productivity (Rolling stock and facilities to allow one-man operation, machinery and equipment for more efficient maintenance)	18,600
Modernization through investment (CTC, automatic signals, and other facilities)	8,900
Reductions in station and yard personnel (More efficient use of personnel, more unmanned stations, freight station consolidation, and automated ticket selling and examining)	11,800
Transfer of selected functions to contractors (Use of contract work forces instead of railway employees in unskilled jobs in stations and workshops)	21,100
Rationalization and closure of local lines (Use of these measures to improve efficiency of unprofitable local railway lines, and replacement of lightly-used local lines by bus service)	15,000
Total	94,900

Facilities and Rolling Stock

	1980	1985
Route length, km	21,322	18,420
Passenger stations:		
Manned	2,892	1,600
Unmanned	2,293	2,870
Total	5,185	4,470
Freight stations	1,358	800
Yards	193	100
Rolling stock:		
Locomotives	4,061	3,600
Passenger cars	29,219	28,000
Freight cars	99,846	92,000
Buses	2,547	2,400
Ferries, total gross tonnage	72,000	65,000

Note: All entries are for the beginning of both fiscal years except route lengths, which are as of the start of fiscal 1980 and the end of fiscal 1985.

5. Major Results Under the Management Improvement Plan

o Revenues and Expenses

The revenues and expenses for 1981, the first year of the Management Improvement Plan, are as shown in the following table. Although trunk line freight revenue decreased from the previous year, revenue from passenger traffic and subsidiary enterprises increased. Efforts were made to reduce personnel and operating costs and to increase non-operating revenues. As a result, the trunk line loss was reduced by 93,100 million yen from the previous year. This is a significant step toward bringing revenues and expenses on trunk lines in balance by the target year of 1985.

Revenues and Expenses

(thousand millions of yen)

Items	Year	1980 A	1981 B	Comparison with previous year B − A	B/A (%)
Trunk lines	Operating revenues	2,563.2	2,708.0	152.8	106
	Operating expenses	2,701.1	2,786.5	85.4	103
	Operating profit or loss	−147.9	−80.5	67.4	
	Non-operating profit or loss	−269.6	−243.9	25.7	
	Net profit or loss	−417.5	−324.4	93.1	
Local lines and bus services	Operating revenues	121.4	124.2	2.8	102
	Operating expenses	460.0	487.3	27.3	106
	Operating profit or loss	−338.6	−363.1	−24.5	
	Non-operating profit or loss	93.3	82.5	−10.8	
	Net profit or loss	−245.3	−280.6	−35.3	
Specific personnel expenses	Specific retirement allowance	−178.4	−263.8	−85.4	148
	Specific pensions	−148.4	−184.8	−36.4	125
	Non-operating loss (interest)	−18.8	−32.3	−13.5	
	Total	−345.6	−480.9	−135.3	
Total (consolidated) and (combined)	Operating revenues	2,674.6	2,830.2	155.6	106
	Operating expenses	3,487.9	3,722.4	234.5	107
	Operating profit or loss	−813.3	−892.2	−78.9	
	Non-operating profit or loss	−195.1	−193.7	1.4	
	Net profit or loss	−1,008.4	−1,085.9	−77.5	
General operating profit or loss (including trunk lines, local lines and local bus lines)		−486.5	−443.6	42.9	

o Traffic Volume

Passenger traffic volume (excluding ferry and bus) registered 192,100 million passenger-km, a decrease of 0.5% from the previous year. This is 0.9% lower than the goal set under the Management Improvement Plan. Freight traffic volume (excluding ferry and bus) sharply declined for the second consecutive year; the figure of 33,400 million ton-km was 9.6% below the previous year and 20% below the goal in the Management Improvement Plan.

Passenger Traffic Volume

(thousand passenger-km)

Item \ Year	1980 A	1981 Goal B	1981 Actual C	Comparison (%) C/A	Comparison (%) C/B
Passenger traffic volume	193.1	193.8	192.1	99.5	99.1

Freight Traffic Volume

Item \ Year	1980 A	1981 Goal B	1981 Actual C	Comparison (%) C/A	Comparison (%) C/B
Freight traffic volume	37.0	41.5	33.4	90.4	80.5

o Personnel Reduction and Productivity Index

Measures for modernization and efficiency have included improvements in work methods, administration and operation systems, as well as increased utilization of outside contractors. The reduction of 12,000 personnel scheduled by the Management Improvement Plan was achieved. The productivity index for 1981 was 4% lower than the goal for this index.

Personnel Reduction

(number of personnel)

Item \ Year	1979	1980	1981	1979–1985 total	1979–1985 reduction goal
A. Annual personnel reduction goal	4,500	11,000	12,000	27,500	74,000
Actual Personnel Reduction: 1. Improvement of work methods & administration systems	1,460	6,530	4,430	12,400	19,500
2. Modernization by combination of investment and measures	3,030	2,560	1,040	6,630	18,600
3. Modernization through investment	940	980	780	2,300	8,900
4. Modernization of assets management systems	1,260	3,460	1,580	8,230	11,900
5. Utilization of outside forces (Contractors, etc.)	2,130	1,980	5,790	9,880	21,100
6. Abandonment or reorganization of local lines	260	1,830	1,200	3,370	15,000
Total	a 10,000	17,010	14,800	40,800	94,900
Increased personnel	b 4,400	6,010	2,800	13,300	20,900
B. Net reductions (a − b)	5,600	11,000	12,000	27,500	74,000
Rate of achievement A/B (%)	100	100	100	-	-

Note: 1979 is the first year of the personnel reduction plan that is part of the Management Improvement Plan.

Productivity Index (Traffic volume per employee)

(thousand passenger-ton-km)

Item \ Year	1980	1981
Goal A	564	585
Actual B	557	561
Comparison $\frac{B}{A}$ (%)	99	96

SHINKANSEN

1. Tokaido-Sanyo Shinkansen

The Tokaido Shinkansen began service between Tokyo and Shin Osaka on October 1, 1964. Its westward extension, the Sanyo Shinkansen, was opened to Okayama on March 15, 1972 and to Hakata on March 10, 1975. The total length from Tokyo to Hakata is 1,069 km. In their first 17 years, Shinkansen trains have carried over 1,700 million passengers without a single casualty.

Two types of trains are operated. Hikari trains stop only at principal stations, connect Tokyo and Shin Osaka in 3 hours 10 minutes, and, on the fastest runs, take only 6 hours 40 minutes for the trip between Tokyo and Hakata. Kodama trains serve all intermediate stations, with typical travel times of 4 hours 14 minutes from Tokyo to Shin Osaka and 4 hours 24 minutes from Shin Osaka to Hakata. In the peak period, as many as 255 trains are operated a day, 138 Hikari and 117 Kodama.

Passengers carried in 1981 totaled 125.6 million (a daily average of 344,000); passenger-km 41,717 million; and the distance traveled per passenger 332 km.

Revenue and Expense

(thousand millions of yen)

Year	1976	1977	1978	1979	1980	1981
Revenue	477.9	615.9	662.6	698.9	728.8	788.9
Expense	296.0	370.5	374.3	399.1	430.5	446.6
Operating ratio (%)	62	60	57	57	59	57

Traffic

Year	1976	1977	1978	1979	1980	1981
Passengers carried (thousands)	157,218	126,796	123,690	123,787	125,636	125,619
Passenger-kilometers (millions)	53,318	42,187	41,074	40,986	41,790	41,717
Average passengers carried per day (thousands)	430	347	339	338	344	344
Average distance traveled per passenger (km)	339	333	332	331	333	332

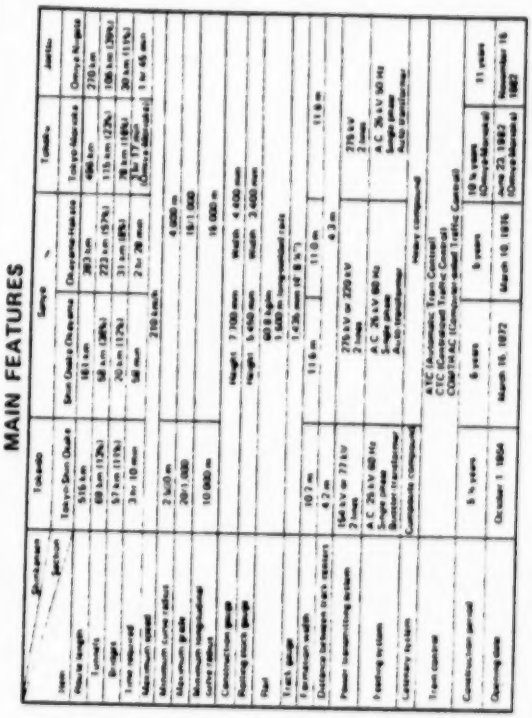
2. Tohoku Shinkansen

The Tohoku Shinkansen was opened between Omiya and Morioka, 465.2 km, on June 23, 1982. Two types of super express trains, similar to those on the Tokaido and Sanyo, are operated – 36 Yamabiko and 24 Aoba. Yamabiko trains stop only at important stations between Omiya and Sendai, then at all stops to Morioka, taking 3 hours 17 minutes; Aoba trains stop at all stations to Sendai, taking 2 hours 17 minutes.

3. Joetsu Shinkansen

The Joetsu Shinkansen began service on November 15 between Omiya and Niigata, 269.5 km. Asahi super express trains operate on 11 return trips, stopping only at major stations, and Toki super expresses on 10 return trips, stopping at each station. Running time for an Asahi train which stops only at Takasaki and Nagaoka is 1 hour and 45 minutes, and for a Toki train 2 hours and 10 minutes, between Omiya and Niigata.

MAIN FEATURES



NATIONWIDE SHINKANSEN NETWORK

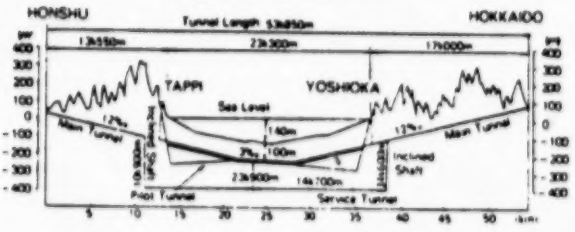
Construction plans for three Shinkansen lines were confirmed by the Law for Construction of Nationwide High-speed Railways, which was enacted in May 1970 to encourage the economic growth and well-balanced land development envisioned in the New Comprehensive National Development Plan of 1969 and the New Economic and Social Development Plan of 1970. Two of these lines opened in 1982; the Tohoku Shinkansen opened between Omiya and Morioka on June 23, and the Joetsu between Omiya and Niigata on November 15. Construction is in progress between Tokyo and Omiya. Some work has also been done on the third new line, the Narita Shinkansen from Tokyo to New Tokyo International Airport.

Five other Shinkansen lines are planned: Hokuriku (Tokyo-Osaka via Toyama), Tohoku (Morioka-Aomori), Kyushu (Hakata-Kagoshima), Nagasaki (Hakata-Nagasaki) and Hokkaido (Aomori-Sapporo). Their construction has been deferred for financial reasons; environmental surveys and other preparatory work are under way on the first three of the five, which are to be given priority. Twelve additional lines have been proposed. Progress continues on the undersea tunnel between Honshu and Hokkaido and suspension road-rail bridges between Honshu and Shikoku.

Seikan Undersea Tunnel between Honshu and Hokkaido

Length:	**53.85 km (23.3 km undersea)**
Max. depth:	**240 m under sea level**
Construction period:	**About 13 yrs, completion set at 1984 at the earliest**
Construction cost:	**About 531,000 million yen**

Profile of Main Tunnel



Suspension Road-Rail Bridges between Honshu and Shikoku

Bridges on the Kobe-Naruto Route ..... Expected cost 1,665,000 million yen

Bridges on the Kojima-Sakaide Route ..... Expected cost 1,110,000 million yen

For the construction of these bridges, the Honshu-Shikoku Bridge Authority was established in July 1970, and construction work on the Onaruto Bridge, one of the two main bridges on the Kobe-Naruto route, started in July 1976.

TECHNOLOGICAL DEVELOPMENT

In order to recover financial stability while continuing to fulfill its vital transporation missions, JNR must operate more efficiently and economically, reduce its work force, and provide needed services with high standards of safety. At the same time, JNR must develop new transport systems and minimize the impact of railway operations on the environment.

In view of the above, JNR is constantly in pursuit of technological progress. Projects carried forward in 1981 include the following:

1. Operational Improvements

(1) Speed Increase for Conventional Lines

Development work continued on new, faster limited express railcars. These cars will be designed to operate at a 130 km/h top speed and 120 km/h through turnouts for passing, without requiring major changes to ground facilities. Research areas receiving special attention included:

- Development of braking systems that will stop trains within 600 m.
- Production of experimental bogies designed for better riding quality and reduced likelihood of track damage.
- Studies of the characteristics of coupling mechanisms for twin-unit articulated vehicles.
- Tests of high-speed running through turnouts.

(2) Speed Increase for Shinkansen Lines

In parallel with research efforts for development of new rolling stock capable of operation at 260 km/h, which is the intended future Shinkansen speed, research continued on the possibility of a speed increase to 230 km per hour by modification of the present 200-series cars. Particular emphasis was given to:

- Tests of car running performance on track that is uneven or out of alignment.
- Studies of bolsterless bogies.
- Studies of powered banking devices for car bodies.
- Production of experimental lightweight cars with a cross-section shape designed for higher speeds.

(3) Energy Saving

Research was continued to develop new technologies for reducing power costs and energy consumption, such as economical driving method, efficiency improvements in direct-jet type diesel engine and power regeneration equipment, vehicle weight reduction, and easier coupling and uncoupling.

Efforts for diversification of energy sources were continued. An example is the use of solar energy as an alternative to oil.

(4) Other Research

Studies were made on other topics, such as reduction of noise from Shinkansen operations and office automation through the use of microcomputers.

2. Safety, Security and Reliability

(1) Research was continued into problems of multiple-cause freight train derailments. Data were collected from running tests and equipment was developed for testing vehicle motion.

In parallel with these field tests, studies will be directed

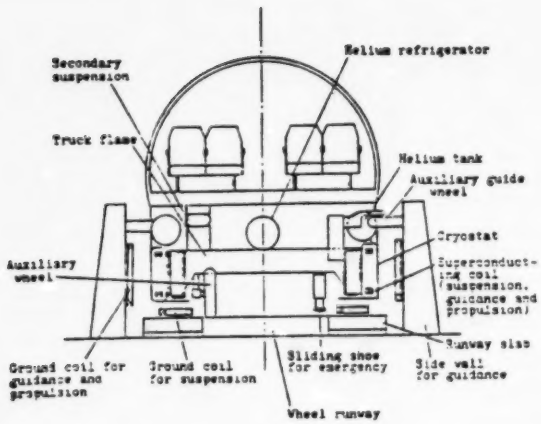
(2) Methods for preventing failures of overhead contact wires and pantographs were examined. Research included the development of contact wires and pantograph pans with good capabilities for resisting wear, detection devices to give early warnings of failures, and equipment and methods to diagnose problems and measure deterioration.

3. Maglev System

JNR continued to experiment with Maglev (magnetically levitated) vehicle technology on a 7-km test guideway near Miyazaki. Test vehicle ML-500 reached a record speed of 517 km/h in December 1979, bringing this series of tests with an inverted-T-shaped guideway to a successful conclusion. The guideway then was modified into a U-shaped configuration, and tests were run with a new vehicle, MLU-001, as a single car and as a two-car train. On September 2, 1982, coupled cars MLU 001-1 and 001-3 reached 262 km/h in levitated operation and for the first time was carrying three persons aboard. A third car has since been added, and tests will continue into 1983.

In parallel with these field tests, studies will be directed toward development of operational concepts for a Maglev system and toward technologies for vehicle control at turnouts, power supply, on-board power sources, and emergency braking. Research will also treat vehicle-guideway dynamics and precise measurement of guideway irregularities, reduction of reactive power, performance of associated equipment, and human body reactions to magnetic effects and to high speed running.

Standard Cross Section of
Test Vehicle and Guideway



ENVIRONMENTAL PROTECTION

1. Shinkansen Train Noise and Vibration

JNR has been making efforts to reduce noise from Shinkansen trains in response to the Environment Agency notification issued in July 1975, "Environmental Quality Standards for Shinkansen Railway Noise," and other related directives.

Noise-source countermeasures have included noise barrier walls along the line and noise dampers on steel girder bridges. These have already been installed as planned. Since 1976, measures have been taken to quiet the air-pressure sound made by trains going through tunnels.

JNR has also requested the cooperation of local governments in negotiations with the great number of residents whose homes have been affected by train noise, and has worked to soundproof or relocate the houses, and take other compensatory steps in these cases.

JNR has carried out house relocation work where train vibrations have been unusually heavy, and has developed and introduced new methods to protect houses from the impact of vibrations.

2. Other Problems

JNR has been working on equipment and procedures for disposal of waste from train toilets, prevention of air and water pollution, and reduction of TV and radio interference.

ENERGY EFFICIENCY BY TRANSPORT MODE

The energy efficiency of railways is relatively higher than other modes of transport. In 1981, trains accounted for 41% of the total domestic passenger-km, while using only 10% of the energy consumption for passenger transportation. Rail freight, 9% of the total domestic ton-km, accounted for only 2% of the total energy used for freight movement.

	Trains	Automobiles	Buses	Other modes	Total
Passenger-km (%)	41	39	10	10	100
Energy consumption(%)	10	69	4	17	100

	Trains	Trucks		Coastal ships	Total
		Privately owned	Common carrier		
Ton-km(%)	9	17	23	51	100
Energy consumption(%)	2	56	25	17	100

INTERNATIONAL COOPERATION

The railway engineering capabilities of JNR are highly valued overseas, especially since the opening of the Shinkansen, and requests for technical cooperation to JNR are ever increasing.

As a means of international cooperation, JNR sends its experts abroad and receives trainees from overseas when requested by a government or a public organization and when considered appropriate by JNR. JNR is doing this as part of national policy.

1. Dispatch of JNR Experts

Requests for cooperation have been coming mostly from the developing countries. Lately, however, JNR has been extending technical cooperation to some advanced countries as well. They include assistance in technical projects of a comprehensive nature, such as modernization of a complete railway system, urban transport as part of city planning, and establishment of an integrated transportation system including railways, as well as in the survey and appraisal of the economic effects of such projects.

JNR complies with these requests and provides its experts as long as this does not unduly hamper normal work. It renders such cooperation through the Japan International Cooperation Agency (JICA) and Japan Railway Technical Service (JARTS), which has been strengthened to deal with expanding requests for railway technical cooperation.

In 1981, JNR continued to extend technical cooperation to many countries in the world, including the U.S.A., China, Zaire, Brazil, Mexico and Bolivia. JNR assigned 219 specialists and experts to overseas technical cooperation positions.

2. Trainees and Visitors from Abroad

Each year JNR receives railway trainees from various countries on request of their respective governments. In 1981, 78 trainees from 21 countries were enrolled through JICA, individually or in groups, to take various courses for two to four months.

Trainees are given a course of lectures by JNR experts. Their field studies include visits to the Railway Technical Research Institute, CTC centers, workshops, construction sites and other railway facilities.

JNR also provides official visitors from abroad with assistance in field visits and discussions with JNR experts. In 1981 they numbered as many as 997 from 62 different countries.

3. Overseas Offices

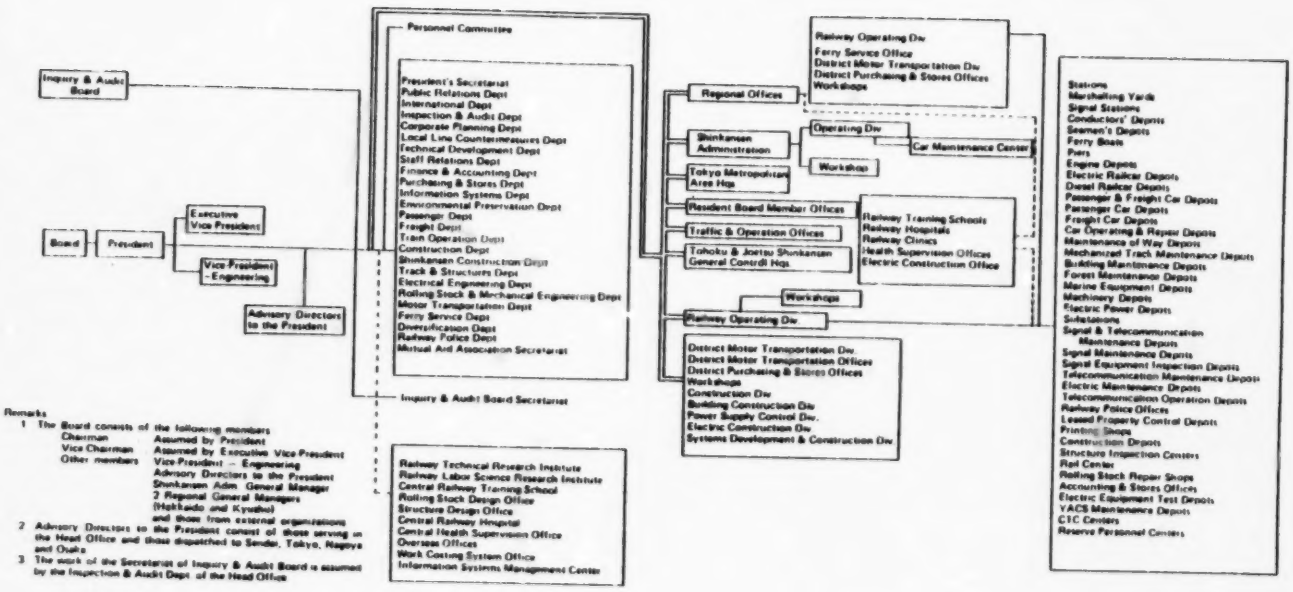
JNR has overseas offices in New York and Paris to study transportation conditions abroad, collect data and information on transportation, arrange JNR participation in international railway meetings, communicate and negotiate with international railway organizations and carry on public relations activities.

CHRONOLOGY

Oct.	14, 1872	First railway in Japan opened to traffic between Shimbashi (Tokyo) and Yokohama.
July	1, 1889	Tokaido Line completed, linking the six major cities of Tokyo, Yokohama, Nagoya, Kyoto, Osaka and Kobe.
Sept.	1, 1891	Tohoku Line (Ueno-Aomori) connecting northern and central Japan, constructed by Nippon Railway Company.
May	27, 1901	Sanyo Line (Kobe-Shimonoseki) opened to traffic, with ferry service between Shimonoseki and Moji, the entrance to Kyushu.
Mar.	31, 1906	Government purchased the majo private railways.
Mar.	7, 1908	Ferry service commenced between Aomori and Hakodate
Dec.	5, 1908	Railway Board set up under the Cabinet.
Dec.	20, 1914	Tokyo Station opened.
May	15, 1920	Ministry of Railways established.
Nov.	1, 1925	Loop operation of Yamanote Line electric railcar trains started.
Dec.	1, 1934	Tanna Tunnel on the Tokaido Line completed after 16 years of work.
June	11, 1942	Kaminon Undersea Tunnel (Shimonoseki-Moji) completed.
Nov.	1, 1943	Ministry of Transport and Telecommunication set up, absorbing Ministry of Railways.
May	18, 1945	Ministry of Transport and Telecommunication reorganized into Ministry of Transport.
June	1, 1949	Government Railways reorganized into a public corporation called the Japanese National Railways (JNR).
Nov.	19, 1956	Electrification of the Tokaido Line completed.
Apr.	20, 1959	Ground breaking ceremony for construction of the New Tokaido Line (Tokaido Shinkansen) held.
Nov.	5, 1959	Container freight train service commenced between Tokyo and Osaka
July	31, 1961	Hokuriku Tunnel (13,870m), world's 5th longest, bored through.
Mar.	30, 1963	Record 256 km/h achieved by a prototype train on the test-run section of the Tokaido Shinkansen.
Oct.	1, 1964	Tokaido Shinkansen opened to traffic.
Oct.	5, 1964	JNR bus service opened on the Nagoya-Kobe Expressway.
Apr.	20, 1966	Automatic Train Stop (ATS) equipment applied to entire system.
Feb.	24, 1972	Record 286 km/h achieved by a new prototype Shinkansen train.
Mar.	15, 1972	Shinkansen extended to Okayama
Sept.	19, 1972	Superconducting magnet levitated, linear induction motor propelled experimental vehicle (ML-100) successfully run.
July	10, 1973	Debut of pendulum electric multiple-unit limited express on the Chuo Line.
Mar.	15, 1974	Shin Kammon Undersea Tunnel on the Shinkansen bored through.
Sept.	3, 1974	Linear motor car-shunting system introduced in Shiohama Marshalling Yard.
Mar.	10, 1975	Shinkansen extended to Hakata.
May	5, 1975	Record 1,032,136 passengers carried on the Shinkansen in a single day.
May	25, 1976	One billion passengers carried on the Shinkansen since its inception
Sept.	21, 1977	Running tests of a superconducting magnet levitated, linear synchronous motor propelled experimental vehicle (ML-500) started at the Miyazaki Maglev Test Center.
Dec.	7, 1979	Record speed of 319 km/h achieved by a train of 961-type cars on the Shinkansen test track, Oyama.
Dec.	21, 1979	Record speed of 517 km/h reached by the Maglev vehicle on the Miyazaki test track.
Dec.	27, 1980	The Law Providing Special Measures for Promotion of JNR Rehabilitation enacted.
June	23, 1982	Tohoku Shinkansen opened to traffic.
Nov.	15, 1982	Joetsu Shinkansen opened to traffic.

JNR ORGANIZATION CHART

As of September 1982



Remarks

1 The Board consists of the following members

Chairman	Assumed by President
Vice Chairman	Assumed by Executive Vice President
Other members	Vice President – Engineering Advisory Directors to the President Shinkansen Adm. General Manager 2 Regional General Managers (Hokkaido and Kyushu)

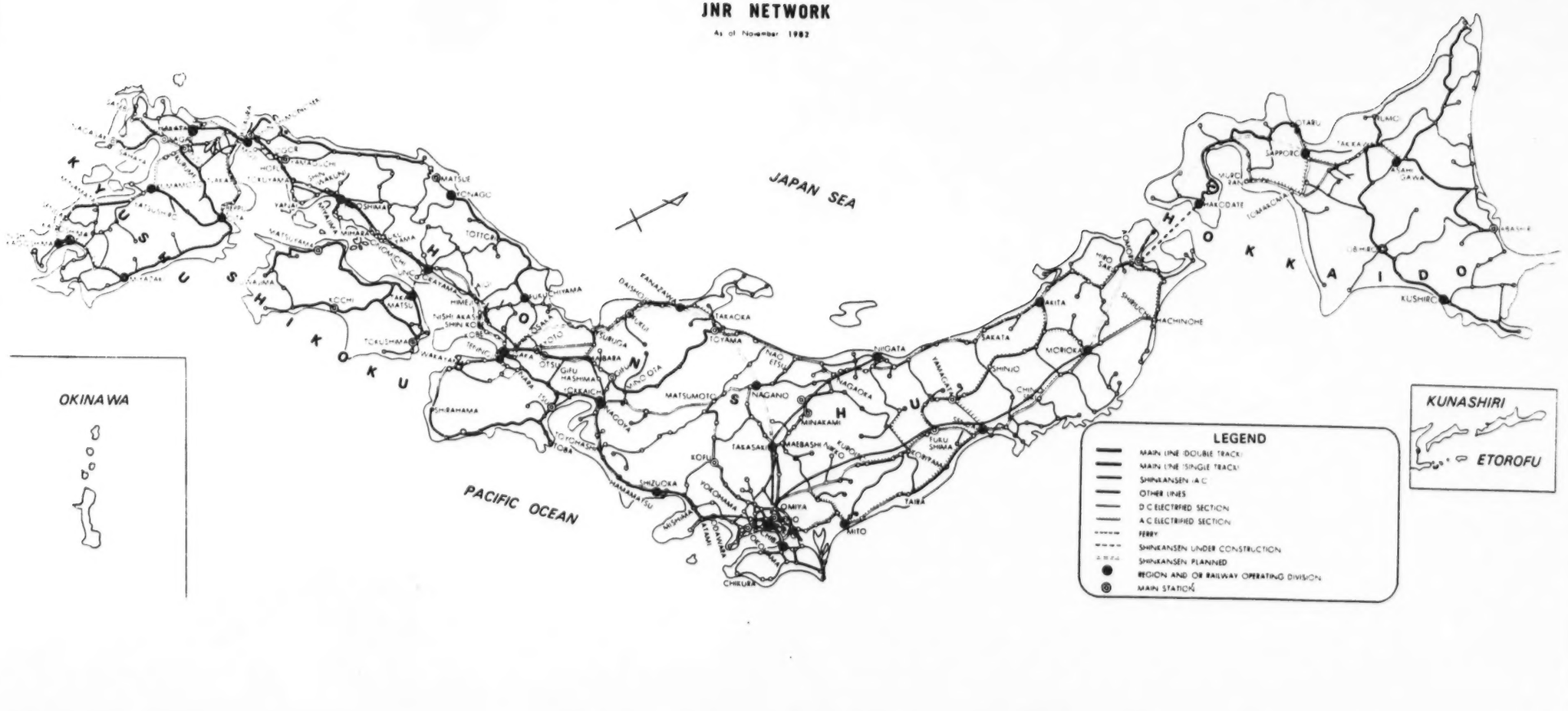
and those from external organizations

2 Advisory Directors to the President consist of those serving in the Head Office and those dispatched to Sendai, Tokyo, Nagoya and Osaka

3 The work of the Secretariat of Inquiry & Audit Board is assumed by the Inspection & Audit Dept. of the Head Office

JNR NETWORK

As of November 1982



LEGEND

- MAIN LINE (DOUBLE TRACK)
- MAIN LINE (SINGLE TRACK)
- SHINKANSEN (A.C.)
- OTHER LINES
- D.C. ELECTRIFIED SECTION
- A.C. ELECTRIFIED SECTION
- FERRY
- SHINKANSEN UNDER CONSTRUCTION
- SHINKANSEN PLANNED
- REGION AND OR RAILWAY OPERATING DIVISION
- MAIN STATION